SILICON CHIP

NOVEMBER 2008
ISSN 1030-2662
11
771030 266001
PRINT POST APPROVED - PP255003/01272
$8.50* INC GST NZ$9.90 INC GST

AirNav RadarBox: WOW!

Track real-time progress of any airline flight – ANYWHERE IN THE WORLD!

Airline: Germanwings
Registration: D-AGWD
Type: Airbus A319-132
C/N: 3011

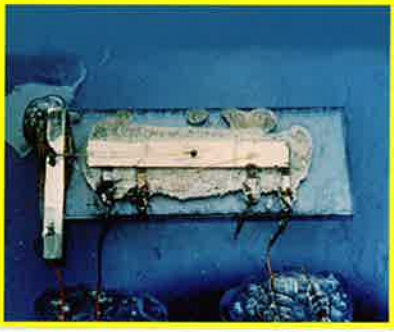
Flight: GWI935

TO BUILD:

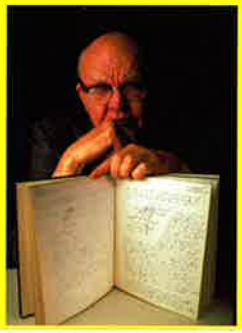
Simple 12V Speed Controller

Engine Oxygen Sensor Display

IrDA board for the Musicolour



Fiftieth Anniversary of the first INTEGRATED CIRCUIT



Jaycar Electronics
Better, More Technical

BIRTHDAY BONANZA...

LINE INTERACTIVE 650VA UPS WITH LCD DISPLAY

Guard your computer and peripherals from the shortfalls of mains power. This 650VA Line Interactive UPS protects against low/over voltage, surges, short circuits and power overloads. In the event of mains failure, the UPS will switch to its battery, which will last for 10-30 minutes depending on the load. The battery power, load, input/output voltage is displayed on an easy to read orange backlit LCD.

- Power management software is included.
- 3 mains sockets
- Dimensions: 324(L) x 155(H) x 95(D)mm

$149.00
Cat: MP-5204

1500VA unit available separately MP-5206 $319.00

802.11n Wireless Networking

Offering the latest in high speed technology, these hi-speed network devices can realise data transfer rates up to 300Mbps and incorporate MIMO technology which uses reflected signals to achieve up to three times the transmission range of older 802.11g systems.

- **The family includes a broadband router and two network adaptors.**

Wireless Broadband Router

This device integrates a router, wireless access point, four-point switch, firewall and advanced encryption protection. Can be managed through a local/remote web and is password protected.
Was $149.95

$129.95
Cat: YN-8300

SAVE $20

Wireless Network Card

Upgrade your desktop computer to the latest high-speed wireless technology.

$69.95
Cat: YN-8302

USB Wireless Network Adaptor

Get up to speed! Upgrade to the fastest wireless connectivity. Suits all PCs and laptops.

$59.95
Cat: YN-8304

LONG RANGE BLUETOOTH DONGLE

Convert your PC to Bluetooth quickly and easily. Communicate with phones, PDAs, headsets and other devices. Fast data transfer, V1.1, V1.2 and V2.0 compliant, class 1.

Range: up to 100m
Transfer rate: 3Mbps
Operating system: Windows 98, ME, 2000, XP

NEW FOR 08

$29.95
Cat: XC-4896

USB ACCESSORIES

USB Spotlight Notebook LED Light

A worklight for your notebook computer. With a quality gooseneck and a separate on/off switch, this handy notebook light has more than novelty value.

- 350mm long

NEW FOR 08

$14.95
Cat: SL-2801

Hollywood Movie Camera USB Webcam

Be a movie star. Broadcast yourself all over the net on your USB movie camera. A strong gooseneck for getting that close-up shot.

- USB powered
- 350mm long
- Image Sensor: 300k pixels
- Resolution: 640 x 480

NEW FOR 08

$29.95
Cat: QC-3227

POLE DANCER LCD ALARM CLOCK

The pole dancer is back! When the alarm goes, your personal pole-dancer goes into her routine, complete with light show and funky music.

- Requires 3 x AAA batteries
- Backlit LCD
- Snooze function
- Dimensions: 120(W) x 200(H) x 100(D)mm

$19.95
Cat: GE-4079

USB RETRO OSCILLATING FAN

Simply plug it into your computer's USB port to feel the gentle breeze. The 3 soft foam blades are encased in a metal cover and with four speeds you can control the air flow.

- Fixed or oscillating modes
- Base measures 100m diameter
- Fan casing measures 150mm diameter

$19.95
Cat: GH-1068

USB MISSILE LAUNCHER WITH WEBCAM

Upgrade to the latest in workstation weapons. This USB missile launcher is equipped with a detachable webcam and software, which allows you to communicate via the MSN Instant Messenger service and remote control your launches.

- New sound effects
- 3 foam WMDs included
- Shoots up to 5 metres
- Dimensions: 110(W) x 125(D) x 185(H)mm

$89.95
Cat: GE-4084

Prices valid to 30th November 2008

Contents

SILICON CHIP

Vol.21, No.11; November 2008 www.siliconchip.com.au

Features

12 Playing With The AirNav RadarBox
Want to track commercial aircraft anywhere in the world? The incredible AirNav RadarBox lets you do it from your armchair – by Ross Tester

17 Review: Jaycar's Sun-In-A-Box Solar Lighting Kit
Looking for a sub-$200 solar lighting kit for the shed, boat or campsite? This kit comes complete with a high-efficiency 10W CIS solar panel – by Stan Swan

24 50 Years Of The Integrated Circuit
It's hard to imagine how we ever got along without ICs but they've only been around for 50 years – by Ross Tester

27 How Oxygen Sensors Work
The oxygen sensor is a critical component in your car's engine management system. Here's a quick primer on how they work – by John Clarke

78 Robot-Operated Clarinet
Clever Australian robot purses lips and plays the clarinet

Projects To Build

30 12V Speed Controller/Lamp Dimmer
Use it as a speed controller for 12V motors rated up to 5A or as a dimmer for 12V halogen or standard incandescent lamps (up to 50W) – by Leo Simpson

35 USB Clock With LCD Readout, Pt.2
Second article details the software installation, describes how to synchronise to an internet time server and deals with firewall issues – by Mauro Grassi

58 Wideband Air-Fuel Mixture Display Unit
Combine it with a wideband oxygen sensor and controller and accurately monitor air-fuel ratios as you drive – by John Clarke

71 IrDA Interface Board For The DSP Musicolour
Add a wireless infrared port to the DSP Musicolour or to virtually any microcontroller project – by Mauro Grassi

Special Columns

40 Serviceman's Log
Yes Serviceman: The Moral Dilemma – by the TV Serviceman

53 Circuit Notebook
(1) Phone Mute System For PA Sound Systems; (2) Converting A Linear Pot To A Log Curve; (3) 12V-High Voltage Inverter; (4) Exerciser For Manual Dexterity; (5) Speed Control For Bosch Cordless Screwdriver; (6) Vandal-Proof Bell Button For Entry Gate

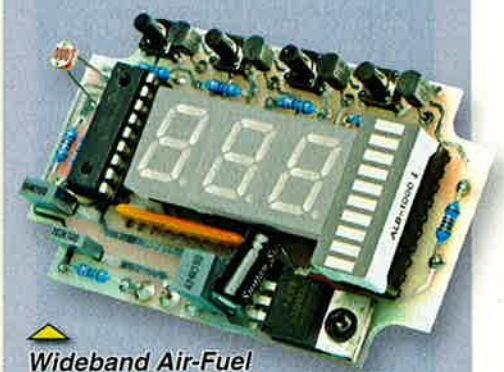
82 Vintage Radio
Those Mysterious Antenna Coils & Loop Antennas – by Rodney Champness

Departments

2 Publisher's Letter
4 Mailbag
70 Book Review
77 Order Form
80 Product Showcase
90 Ask Silicon Chip
93 Notes & Errata
94 Market Centre

Jaycar's Sun-In-A-Box Solar Lighting Kit – Page 17.

12V Speed Controller/ Lamp Dimmer – Page 30.



Wideband Air-Fuel Mixture Display Unit – Page 58.

IrDA Interface Board For DSP Musicolour – Page 71.

SILICON CHIP
www.siliconchip.com.au

Publisher & Editor-in-Chief
Leo Simpson, B.Bus., FAICD

Production Manager
Greg Swain, B.Sc.(Hons.)

Technical Editor
John Clarke, B.E.(Elec.)

Technical Staff
Ross Tester
Jim Rowe, B.A., B.Sc, VK2ZLO
Mauro Grassi, B.Sc.(Hons.)

Photography
Ross Tester

Reader Services
Ann Morris

Advertising Enquiries
Glyn Smith
Phone (02) 9939 3295
Mobile 0431 792 293
glyn@siliconchip.com.au

Regular Contributors
Brendan Akhurst
Rodney Champness, VK3UG
Mike Sheriff, B.Sc, VK2YFK
Stan Swan

SILICON CHIP is published 12 times a year by Silicon Chip Publications Pty Ltd. ACN 003 205 490. ABN 49 003 205 490 All material copyright ©. No part of this publication may be reproduced without the written consent of the publisher.

Printing: Hannanprint, Noble Park, Victoria.

Distribution: Network Distribution Company.

Subscription rates: $89.50 per year in Australia. For overseas rates, see the subscription page in this issue.

Editorial office:
Unit 1, 234 Harbord Rd,
Brookvale, NSW 2100.

Postal address: PO Box 139,
Collaroy Beach, NSW 2097.

Phone (02) 9939 3295.

Fax (02) 9939 2648.

E-mail: silicon@siliconchip.com.au

ISSN 1030-2662
*Recommended and maximum price only.

Publisher's Letter

Electrolysis of water in cars is a fuel economy mirage

Two month's ago, in the September 2008 issue, I answered a question from a reader concerning the supposed manufacture of Browns Gas. This is the mixture of hydrogen and oxygen evolved from the electrolysis of water. It is called Browns Gas in some sort of canonisation of the ratbag engineer (Yull Brown) who promoted the process in Australia some 30 years ago. This Browns gas is injected into the engine's inlet manifold to be burnt in the cylinders. Depending on the site where you find this topic, this is claimed to give large gains in fuel economy.

Confronted with this nonsense, I gave a fairly detailed answer on the question in the hope that it might kill off the whole silly idea. But guess what? Since then we seem to have had a rash of questions on the topic. Mostly these questions are related to pulse width modulation circuits which could be used to drive the electrolysis process and also control the current drawn, as it tends to "run away". None of the people who contact us on the topic have any idea that it is just a silly idea. This is another consequence of a population who have very little knowledge of science and technology.

Obviously my attempt to discredit the whole concept has so far been a complete failure. There seems to be an increasing interest in the process, possibly driven by the production of hydrogen-powered prototype cars in the USA. It should be obvious that this is a technological dead-end, but that is another story, associated with the attempt to kill off the electric car in the USA some years ago. So without repeating all of what I wrote in the September issue (pages 89-90), let's attempt to dispassionately review the topic of producing hydrogen in a car so that it can be burnt in the engine.

First of all, the electrolysis of water into hydrogen and oxygen is a simple but energy intensive process, even when platinum electrodes are used as a catalyst. The popular internet process using stainless steel electrodes is much less inefficient. To generate any significant amount of hydrogen, you need large amounts of energy. That energy has to come from the car's electrical system (ie, battery and alternator) driven by the engine and fed from the petrol tank. It should also be obvious that you also need to carry substantial quantities of water – which is even heavier than petrol or diesel.

So we attempt to run a very inefficient chemical process in order to get some hydrogen and oxygen to be used in the car's engine. The claimed result of this process is an overall improvement in fuel economy – as much as 15% according to some claims.

To me, this just beggars belief. If it was that easy to get such a major increase in fuel economy, why hasn't a single car manufacturer ever done it? Why have the car manufactures resorted to ever increasing complexity in their engines to eke out fuel economy improvements over the decades? Why have Toyota and Honda developed even more complex hybrid cars such as the Prius, Insight, Civic and others, to get better fuel economy? Confronted with these questions, some people start to mutter about oil company conspiracies . . .

Just in case, people don't get the message, this process does not improve overall fuel economy in the slightest – it can only lead to a decrease.

On the positive side, I suppose it is good that so many people are thinking about ways of improving fuel economy in cars. It is just a great pity that more people cannot see the blindingly obvious approaches to saving fuel: (1) Drive a light car with a small engine and (2) drive less.

Leo Simpson

Tribotix

Whether you need a robot for research, an educational robot or just a robot to have some fun with then we have a robot to suit your needs.

Tribotix's custom designed Robots and electronics ....

HyKim
21 DOF Robot Bear

Tribotix are now developing our own robots and associated processing systems.

HyKim, a 21DOF robot bear, is one of the worlds most advanced commercially available robots.

HyInt is the powerful processing system used within HyKim. HyInt is based around a 500MHz AMD Geode processor that can communicate at 1Mbps with Robotis's range of Dynamixel modules. This allows HyInt to be used as the main processing system in any Dynamixel based robot.

Robotis CycloidII with **HyInt** fitted.

Featured product .... RoboBuilder wCK modules & Robot Kits

5710K Creator Kit (18wCK modules)

RoboBuilder have created a fantastic robot kit based are around their highly configurable **wCK** range of **serially controlled servo modules**. RoboBuilder's Creator Kits are now compatible with Microsoft Robotic Studio (MSRS).

The **wCK** modules are unique, not only can the PID characteristics of each module be adjusted, but each wCK module has 2 Analog outputs and 1 Digital Input.

The **wCK** modules can also be programmed to perform simple sequences, without the need for a host mcu. The wCK modules are well worth considering for your next project.

Other products we supply ....

CoroWare

Robotis

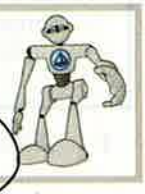
KumoTek

Kondo

POB Technologies

Mention this add and receive ***free shipping within Australia*** for all orders placed before 25/12/08.

Tribotix Pty Ltd • ABN 23 108 604 226
p:+61 2 49578255 • f:+61 2 49578244
e:info@tribotix.com • w:www.tribotix.com



3

MAILBAG

Letters and emails should contain complete name, address and daytime phone number. Letters to the Editor are submitted on the condition that Silicon Chip Publications Pty Ltd may edit and has the right to reproduce in electronic form and communicate these letters. This also applies to submissions to "Ask SILICON CHIP" and "Circuit Notebook".

A balun IS a transformer

Thank you for including my recent letter in the October 2008 edition of SILICON CHIP magazine. However, the more I think about it, the more I'm sure that your definition of a balun is technically incorrect. As SILICON CHIP shows the diagram of a balun (page 40, August 2008), it clearly represents a simple coupling transformer with a primary and a secondary, as per conventional transformer definitions, with the core used for coupling energy.

In the "choke" balun, as used in typical RF antenna applications, the choke balun windings are closely coupled as a tight bifilar winding and the RF energy is transferred essentially in "transmission line mode" between the windings and not as in a conventional transformer through flux linkages. The core plays a significant role but not the critical one. It serves mainly to improve the low-frequency response of the balun. This analysis is the definition as explained in the book 'Transmission Line Transformers', Third Edition by Jerry Sevick W2FMI, a world authority on baluns for RF applications.

Felix Scerri, VK4FUQ, Ingham, Qld.

Comment: by definition a "balun" is a "balanced to unbalanced" transformer. It serves to couple signals from a balanced circuit (eg, a dipole antenna) to an unbalanced circuit (eg, a receiver input stage with one side referenced to earth). You refer to "windings that are closely coupled". That describes a transformer.

A transformer does not need a core to be a transformer. Air-cored transformers are common in RF applications, apart from those referred to as baluns.

None of the material you quote from the textbook "Transmission Line Transformers" contradicts this. Arguably, it merely obscures the point. Any basic transformer consists of two or more windings coupled together. Flux is created by the primary winding and is coupled to the secondary, whether there is a core or not.

Furthermore, even where a balun is made from lengths of coax cable (transmission lines) and has no obvious windings, it can still be shown to be a transformer, with flux being coupled from one circuit to another.

TV could be used for education

The editorial in the September 2008 issue touched a nerve, at least as far as I am concerned. It echoed thoughts that I have had for at least 30 years.

Although your editorial was directed at HDTV, the same could be said for TV in general. Probably no other medium reaches such a high percentage of the population.

I know that it means different things to different people but there are many programs watched simply because the watcher considers there is really nothing else to do. It is also often used as a babysitter for the young. How many young, fertile minds have lacked development due to endless hours of so-called entertainment?

Sometime during the 1980s I recall a computer education program on the ABC but there has been precious little else. Sure, there are very informative documentaries but these are of a general nature. Who said that TV has to be restricted to entertainment anyway?

Education via TV could help to reverse the current skills shortage without clogging up over-crowded teaching institutions and occupying teachers who are over-stretched anyway. Such institutions could then be used for less-time-consuming assessments after personal/private study via TV.

The training concept opens up a whole new range of potential advertisers for the broadcasters. How many electronics-related suppliers currently advertise on TV? Electronics-related training programs would surely bring a few of them out.

Kevin Crockett, Axedale, Vic.

Do not wire to the Active pin

I agree that it's a very bad idea for D. J. to use a 240V power board for 12V. But the obvious simple change to make it a lot safer would surely be to rewire it from +12V on the Active pin and common on the Neutral pin to +12V on the Neutral pin and common on the Earth pin?

Gordon Drennan, Burton, SA.

Comment: ostensibly that is a safer approach but if a plug wired in this way is connected to a power point which has Active & Neutral transposed (not an uncommon situation), you still have a potentially dangerous situation – both for the equipment and the user. There is really no way around it – it is just a very bad idea.

Safe alternatives to 240VAC hardware for DC

Like the SILICON CHIP staff, I was horrified at the photograph of D. J.'s use of 240V AC mains plugs/power boards for 12V use (Mailbag, October 2008).

I disagree with SILICON CHIP's and D. J.'s contention that it is "impossible to buy suitable plugs and sockets to carry 12V power." Both Jaycar and other suppliers carry suitable, rugged, polarised 2-pin 12V hardware especially for this application. I refer

Digital TV is unsatisfactory

Your editorial on digital TV in the September 2008 issue was spot on. I have long been frustrated at the digital TV situation.

We the consumers have the advantages of digital TV available to us but much of its capability is not being used. Several channels are available but these often show the same program and in the case of the high-definition channel, nothing but confusion.

TV stations should not be allowed to up-convert standard definition onto their high-definition channel for starters. This only creates a misconception of what high-definition is. SBS is an interesting situation where sometimes their SD channel (with the same program) looks better than their HD channel (at least in Perth).

Also what one would assume are HD programs, such as movies, look no different on the SD and HD channels. Why?

Then there is the sound situation, which for the average consumer is nothing but a complete lack of understanding. I worked in the television industry all my life and I'm confused when it comes to figuring out the sound into a surround sound system and configuring the complete system. Sometimes movies are advertised as "surround sound" when they appear not to be.

Added to all this, we are seeing what were widescreen programs shown as 4:3 copies and even more frustrating is that some 4:3 widescreen copies have a black border around the screen. Why must we put up with not seeing the entire picture or the entire widescreen picture but at a small size?

Where does the ACMA stand (or fall) in all of this?

Will McGhie,
Lesmurdie, WA.

to the current Jaycar catalog, page 196, top left. These devices will carry 15A which, judging by the gauge of the wire coming out of the plugs in the photograph, should be more than adequate.

I do suspect, however, that D. J. was looking for a low-cost solution to his application. When I was a struggling electronics constructor it was common practice to use microphone connectors for 12V power. These appear on page 189 of the Jaycar catalog. As you can see, they are similar in price to the dangerous alternative he has chosen. From memory you could pass between 5-8A through the 2 & 4-pin units.

There are other low cost alternatives which also avoid the use of dangerous 240V hardware.

Gary Johnston,
Managing Director,
Jaycar Electronics,
Rydalmere, NSW.

Clipsal DC plugs

You are quite right in what you said in your comment about 240V plugs for 12V. However, Clipsal make a 2-pin plug for use at this voltage. Its part number is 492/32 and it is rated at up to 32V AC/DC and 15A.

Incidentally, I know of some people who use 3-pin mains plugs with their old 32V DC generators. The difference is that they use the Neutral and Earth pins. They do this so that if they accidentally plug them into the 240VAC mains, the electrical equipment in question will not be damaged.

Stephen Hunter, VK3TSH,
Lilydale, Vic.

Comment: see our comment above about the danger of Active & Neutral transposition at the power point. In short, we strongly advise people not to do it.

Wrong connections do happen

The Mailbag section from October 2008 reminded me of the following event 40 years ago. The school secretary asked if I would have a look at the PA system in a local progress association hall. The complaint was that the PA system when switched on made a very loud noise and blew the mains fuse.

On inspection, the output of the home-built valve amplifier was terminated by a 3-pin mains socket on the

Atmel's AVR, from JED in Australia

JED has designed a range of single board computers and modules as a way of using the AVR without SMT board design

The AVR570 module (above) is a way of using an ATmega128 CPU on a user base board without having to lay out the intricate, surface-mounted surrounds of the CPU, and then having to manufacture your board on an SMT robot line. Instead you simply layout a square for four 0.1" spaced socket strips and plug in our pre-tested module. The module has the crystal, resetter, AVR-ISP programming header (and an optional JTAG ICE pad), as well as programming signal switching. For a little extra, we load a DS1305 RTC, crystal and Li battery underneath, which uses SPI and port G.
See JED's www site for a datasheet.

AVR573 Single Board Computer

This board uses the AVR570 module and adds 20 An./Dig. inputs, 12 FET outputs, LCD/Kbd, 2xRS232, 1xRS485, 1-Wire, power reg. etc. See www.jedmicro.com.au/avr.htm

$330 PC-PROM Programmer

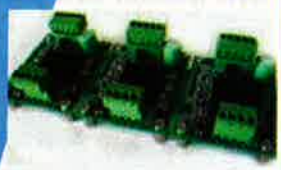
This programmer plugs into a PC printer port and reads, writes and edits any 28 or 32-pin PROM. Comes with plug-pack, cable and software.

Also available is a multi-PROM UV eraser with timer, and a 32/32 PLCC converter.

JED Microprocessors Pty Ltd
173 Boronia Rd, Boronia, Victoria, 3155
Ph. 03 9762 3588, Fax 03 9762 5499
www.jedmicro.com.au

OCEAN CONTROLS
Helping to put you in Control
Control Devices

New Bipolar Stepper Motor Driver Cards for your CNC Small 1, 2 or 3 axis bipolar stepper motor driver cards with full, 1/2, 1/4 and 1/16 micro-step modes. Power motors up to 2.5A 30VDC. **Prices from $79.00+GST.**



Serial Stepper Motor Controller Our KTA-190 serial stepper motor controller can control 4 stepper motors using serial ASCII commands. Now with 2 relays. **$69.95+GST**

Parallel Interface Card. The KTA-205 allows you to easily interface to stepper and servo motor drives and limit switches from your PC Parallel Port. Fitted with 2 relays. Mach 3 compatible **$45+GST**

AVRISP-MKII In-System Programmer is an In-System Programmer for Atmel's AVR® Flash microcontrollers. Plugs into the USB port. **$75+GST**

Dual Pump Controller Configure pumps to empty wells or fill tanks. Allows Duty/Standby or cyclic control. Can operate off Level or float switches or both. **$575+GST**

Dual Frequency to Voltage Output card Easily convert up to two frequency signal streams to an analog voltage signal DIN Rail mount available **Prices from $99+GST**

Contact Ocean Controls
Ph: 03 9782 5882
www.oceancontrols.com.au

Using a tachogenerator with a series motor

I noticed the reply to J. D. in "Ask Silicon Chip" regarding using the High Current Speed Controller on a series motor (page 97, October 2008). Although I can't speak for the controller mentioned, I can comment on using the June 1997 controller (modified) with a 2-3HP series motor, recently fitted to an old Schnapper ride-on mower.

I found that because the series motor does not produce any back-EMF when there is no current flowing through it (ie, when the Mosfets are in their off condition), the speed regulation was almost non-existent and of course, there was little or no dynamic braking. Series motors also tend to rotate rather fast when they have little or no load on them, so I was forever continuously varying my "throttle" control.

My solution was to have my series motor drive a separate small DC permanent-magnet motor, to use it as a tachogenerator. I then fed the voltage it generated back into the feedback circuit of the controller. After making a few minor modifications to the circuit and after adjusting the amount of feedback, this method gave very good speed regulation for the series motor in question.

Furthermore, larger series motors also have four connections on them as you are no doubt aware. This means that the field & armature windings can be changed over to get the motor to turn in the opposite direction.

Brian Playne,
Toowoomba, Qld.

chassis and the speaker lead terminated across the Active and Neutral pins of a 3-pin plug. The usual procedure was to disconnect the mains and the speakers after each use of the PA.

Surprise, surprise! Eventually the plugs were placed in the wrong sockets the next time the PA was to be used. Amazingly, the speakers survived this application of raw 240AC mains.

The following week, the committee decided to replace the whole PA system.

Col Hodgson,
Wyoming, NSW.

DC power for 12V cordless drills

I agree with your superb warning on page 8 of the October 2008 issue regarding using a 240VAC power board for 12V DC. But there is a really simple solution. Electrical suppliers have 32V 15A fittings such as polarised plugs, line sockets, surface-mount outlets and outlets on a steel adaptor bracket which will fit into a standard weatherproof box for 240VAC switches and GPOs.

They are rugged, polarised and are a completely different configuration to 240VAC fittings, so there is no confusion.

We have been using them for 20 years or so in our workshop where I have 12V to run cordless drills with "dead" batteries. I remove the batteries, fit some figure-8 lead and one of these plugs. They do thousands of screws before a 30 amp-hour battery needs to be re-charged.

I could barely believe that a person who must have some technical nous actually admitted that he had done this and said "hope the idea catches on". Incredible!

Ranald Grant,
Brisbane, Qld.

Test result should be carefully interpreted

I have a comment concerning the Metrel Instaltest AS3017, reviewed in the September 2008 issue. As an electrician, I would have loved such a tester but I had to survive by just cranking a Megger.

My comment is in relation to the concept of a pass/fail result. I firmly believe that any test equipment is only as good as the user's ability to interpret the results. I have seen numerous Electrical Safety Testers working in our area using such equipment and accepting a "Pass" result regardless of the data produced.

I know that most IEC power cords have an earth continuity resistance of about 0.05Ω. If I find one which reads 0.5Ω and it is not light-duty or extra

long, I will cut it in pieces and throw it away – even though it technically passes. With a resistance that high, it has to have problems and is likely to fail in the near future – I would not trust it.

I hope that electricians using the Instaltest AS3017 will know enough about Ohm's Law to not just look at the "tick" and learn to interpret the actual results.

Incidentally, I have found three moulded power cords which had been wrongly wired, so we test all new equipment.

Robin Cole, Equipment Officer, Ludwig Institute for Cancer Research, Parkville, Vic.

Eveready 276-P battery equivalent

In your response to an email from B. H. (Ask SILICON CHIP, September 2008, page 90), you say, incorrectly, that there is no equivalent to the Eveready 276-P 9V battery. In fact, the Varta 439 is a suitable replacement. Most independent electronics stores would be able to order them from the distributor, Master Instruments. See **http://www.master-instruments.com.au/products/54540/439.html**

John Oakhill, Cotton Tree, Qld.

Comments on simple valve amplifier

I was very pleased to see the simple valve amplifier submitted by Dayle Edwards, in the Circuit Notebook pages of the September 2008 issue. I have used similar amplifier circuits for some of my low-power projects and the basic design is a good one. However, without any intention of being critical, something that immediately caught my attention was the rating of the power transformers.

Given that a 12AX7 draws 150mA @ 12.6V for its heater, the 300mA specification for T1 is inadequate, as this is also driving the high-tension transformer, T2. Assuming the high tension current will be about 20mA, this means the 12V winding of T2 would be drawing about 400mA. T1 has to supply this as well as 300mA of heater current and therefore should have a 1A secondary (eg, type 2155) and T2 upgraded to something with a 500mA 12V winding (eg, type 2853). It is also good practice to earth one side of the heater supply.

Incidentally, given a choice of valves, the 12AU7 or 12AT7 is more suited to this application, with the 12AT7 being the better choice of the two, if higher gain is required. A 12AX7 may have its ratings exceeded when used as an output valve. With consideration given to the heater supply, other common valves which could be used include 12BH7, 6CG7 and 6SN7.

These are all medium-mu triodes similar to the 12AU7. Ideally, the bias conditions should be set for different types of valves but in this situation the given values are a suitable compromise.

A further increase in gain can be had by changing the 180kΩ output triode grid resistors to something like 1MΩ and the V1a/V2a plate resistors to around 270kΩ. The 220kΩ grid resistors for these triodes, along with their associated 100nF coupling capacitors, could be omitted as the volume control potentiometer will complete the grid circuit and DC isolation is already provided at the input.

The 100nF bypasses for V1a and V1b will have no effect except at the high

Tunnel software must include a watchdog

I was amazed (yet again) to see that a traffic tunnel has been closed by a so-called software glitch (ie, the Sydney M5 tunnel on 22nd September, 2008). I have worked as an engineer on major industrial projects such as these for 40 years and this excuse just won't wash.

All computer-controlled systems *must* have a simple *watchdog* circuit which, in the case of computer failure, automatically switches all fans, lights and other safety devices *full on*.

The computer can then be fixed at leisure and once it is fixed, it regains control.

I cannot believe that complex public works such as these tunnels apparently don't have a simple *watchdog* in the specification.

Also primary safety devices like ventilation fans and lighting should have alternative sources of power such as a back-up diesel alternator. This would start automatically on any power failure.

For more information on failure analysis look at: **http://en.wikipedia.org/wiki/Failure_mode_and_effects_analysis**

I was out at a big shopping centre the other day showing a young engineer how to switch all the fans to manual in the Motor Control Centre (MCC) in case of a control system failure. I suppose the tunnels do have an MCC and manual controls and the "engineers" know where it is!

John Rich,
Petersham, NSW.

end of the audio spectrum. Likewise, the output valve cathodes could be bypassed with at least 100µF to improve low-frequency response.

If one was buying the output transformers new, 100V PA line transformers would be preferred instead of power transformers. At the low plate current, it is unnecessary to rearrange the core laminations.

John Hunter,
Hazelbrook, NSW.

TV programming is getting worse

Your Publisher's Letter on High Definition TV was correct – programming is just getting worse and worse. As a TV repair and antenna technician, I talk to hundreds of people and all have the same reaction.

I asked an ex-producer for the Seven network why one of their productions (All Saints) had such awful picture quality when the scripting and production is to a high standard – it looks as though we are viewing it through a tinted glass window. His reply was that it is done on purpose. They use a tinted filter on the lens; it is clear at the centre but is progressively darker towards the edge. And the reason? If viewers are flicking through the channels they are more likely to watch it if it looks like an old movie, so the picture is downgraded to that level.

It seems as though all those people who have created HD technology have wasted their time. Perhaps the producers should watch that UK program *The Bill*. That has outstanding picture quality, with high definition and perfect lighting.

We are all changing to HD plasma or LCD sets and we all want excellent picture quality and better programming to go with them.

Arthur Hadfield,
Kempsey, NSW.

Comment: we find your observation about the picture quality of the "All Saints" program on the Seven Network a little puzzling, as we have not noticed an inferior picture.

Solar panels on cars

With all the recent discussion about electric vehicles and hybrids, where are the solar cells? I agree that home solar arrays are not as economical as large renewable installations and at this stage they cannot compete with coal or gas on price. However, when you have to generate your own electricity, solar cells do make sense.

So why aren't they fitted to car roofs? We all use petrol, diesel or gas to generate electricity in our cars; even those of us with "normal" cars. So why don't manufacturers offer solar cells on the roof and why isn't there a flourishing aftermarket industry? Even without having the headlights on, we are drawing a fair current from the battery during normal running, which could be supplied or gradually replaced by a solar array which is active when driving the car or parked in sunshine.

This would be of even more benefit to an electric/hybrid vehicle. How hard would it to have a thin stick-on solar array on the car roof?

I also wonder why the electric-powered "gofers" you occasionally see trundling toward the shopping centres don't have some solar cells on their sun-shade roof. It would extend their range.

Ken Wagnitz,
Hawthorndene, SA.

Teletext playback requires a timebase corrector

I read with interest Geoff Nicholls' letter to Mailbag (October 2008), stating that Allan Hughes was NOT correct in claiming that no videocassette machine could record undecoded teletext subtitles, or words to that effect. While that is indeed true of S-VHS recorders, the story is not that simple. It is the playback that causes the problem irrespective of system bandwidth.

A standard VHS recorder will neither record or playback teletext encoding. By contrast, a normal S-VHS recorder will record teletext but cannot play back a stable enough signal for the TV receiver to decode coherent teletext without the help of a timebase corrector, in most if not all cases.

What Mr Nicholls forgot to mention was that the JVC HR DVS1 has the luxury of a built-in timebase corrector (TBC), a necessary adjunct for the operation of the DV deck included with the S-VHS unit. I don't know of any SVHS/VHS only recorder with a TBC included; certainly not a domestic machine. It should also be mentioned

that some TBCs, unless specially set up, will remove all traces of Teletext if they regenerate the vertical blanking period in its entirety.

For those readers not familiar with time base correctors, they may be described as a memory device that receives video signals whose time stability is only as accurate as the rotational speed of the video heads and to a lesser extent, the capstan drive. The video signal is then read out of the memory at a precise rate, usually referred to a quartz crystal or better as the timing reference, usually a sync pulse generator. The system reduces the errors from many tens or even hundreds of microseconds down to a few nanoseconds, just fine for a crystal-controlled Teletext decoder to function correctly. And of course it's ideal for the TV's PAL decoder.

I have simplified this explanation and yes, one can quasi-stabilise the PAL part of the signal without a TBC but not without degrading the picture quality or losing chrominance/luminance coherence.

I entirely agree with the comments made by Allan Hughes in his reply regarding the scarcity of S-VHS recorders in Australia. I have obtained a few S-VHS recorders during the past five or so years and in each case none would replay stable Teletext without the use of a TBC; the mechanics were worn and except for one machine, the heads were in need of replacement. Also, it is now difficult to source S-VHS tape.

All of my remaining S-VHS footage is now being dubbed to DVD and a large HD before the remaining heads fail and the oxide falls off the tape or worse.

Victor G. Barker,
Gorokan, NSW.

Life lost through defective home wiring

I have been reading the various opinions on homeowners doing their own wiring. However, some people definitely should not have anything to do with 240VAC, as my story demonstrates.

We lived in a house in the 1970s where the roofing iron was fixed to the same beams as the ceiling, giving a unique sloping ceiling and making it necessary to keep a spirit level in the drawer to prove to visitors the pictures were straight – but I digress.

One day, we became aware of a terrible smell coming from the ceiling cavity and I had to systematically remove the roofing iron until I eventually found a dead possum and an old flue pipe where it had got in. After removing the possum, I was scraping back the insulation while leaning on the roofing iron when my hand touched the sarking on the top of the ceiling Gyprock and I received an electric shock.

I returned with my multimeter and found that I had 240V between the sarking and the roofing iron! The roof had attached gutter and downpipes that went into the ground, explaining the possum's death.

I found the cause to be a brass lamp in our bedroom where the previous owner had joined the Active wires to the screw traditionally reserved for the Earth.

TENROD
Sealed Flexible Lights
Delightful Lighting Effect with stick-on flexible LED strip
• High Brightness LED
• Split-able at any 3-LED unit
• 12 VDC
• Sealed in water resistant envelope
• Self adhesive underside taping
• Now available in stock
• White, Warm-White, Blue, Green, Yellow, Red
Solar Modules in Stock
2W6V
5W
10W
10W
20W
40W
85W
130W
Silicon Photo Voltaic Solar Modules for 12 volt operations
• High Quality Anodized Aluminium Frame
• High Transmission Toughened Glass
• High Performance Silicon Cells
Quality System
Quality Endorsed Company
ISO9001 : 2000
www.tenrod.com.au
sales@tenrod.com.au
NSW: tel: (02) 9748 0655 fax: (02) 9748 0258
VIC: tel: (03) 9886 7800 fax: (03) 9886 7799
QLD: tel: (07) 3879 2133 fax: (07) 3879 2188
Unit 1, 24 Vore Street Silverwater NSW 2128

DIY wiring in USA and Canada

I was delighted to read the article "Are Aussies Dumber Than Kiwis" by Ross Tester and the Publisher's Letter in the June 2008 issue.

Apart from NZ, Canada's "Home Building Center", "Home Hardware" and "Canadian Tire", all major chains across Canada, and "Home Hardware" in the USA, sell a large range of DIY electrical fittings and provide "how to" brochures dealing with all manner of household wiring and fittings installation.

In Ross Tester's article, he mentions that in Queensland one is not even allowed to replace jug elements. About six years ago I recall a conversation with a licensed electrician also heavily involved with workings at the ETU office in Melbourne. At the time there were moves afoot (failed thankfully), to require a licensed electrician to work on ANY domestic equipment that had connection to the mains.

That included but was not limited to, audio amplifiers, cassette decks, CD and DVD players. Imagine the cost ramifications, not to mention the lack of skill, required for repairs to these units. (It takes years of training and knowledge to be a competent electronics technician, then many more years as an apprentice in training to get an electrical license).

Fortunately, it seems that common sense prevailed; most equipment would be too expensive to repair and it would be cheaper to dump it and buy new! So much for recycling and minimising waste!

After many years of installing telephone, computer and security wiring in new, commercial installations (I have an approved Austel Customer Premises Cabling license), I really hope that the "sparkies" involved in running mains at the same time didn't have anything to do with the wiring in MY house!

Keep up the good work with a great magazine.

Terry Penman,
Preston, Vic.

Furthermore, the screws holding the lamp to the ceiling had been driven through the sarking. I had previously changed several light bulbs so obviously standing on the bed was a good insulator.

Tony Rossiter,
Ridgehaven, SA.

Motorised shutters can be silenced

I came across a question in "Ask SILICON CHIP" (page 88, September 2008) about motorised roof shutters. Having been an installer for the electrical side of these devices, I can state that the brand I worked with used an electronic type of controller. This controller monitors the current flow to the motor and when it suddenly rises at the fully open or closed positions, it turns the motor off.

The easiest way to silence the crashing noise would be to buy some foam weather sealing tape about 5mm thick and run this along the shutter blades where the edge of the next blade lands (the majority of these shutters have an interlocking shutter design so water can't get through).

This will provide cushioning for the blades and mute the noise as they fully close, without voiding the warranty. However, the warranty will be voided if there are any changes to the control circuitry, wiring to the motor, the motor itself or the mains lead.

Note that almost all of these devices are connected to mains power through the control box and opening this will expose people to 240VAC wiring, with the potential for fatal shocks.

Brad Coleman,
via email.

Basslink and wind generators

Regarding the September 2008 article on Basslink, it is interesting to note that there is one insulated cable (for 400kV) and one which is called a metallic return, presumably insulated for a much lower voltage. There was discussion about using two fully insulated cables (one for positive and one for negative) or the cheaper alternative. Apparently, the cheaper version is not used overseas any more.

The answer in "Ask SILICON CHIP" (September 2008, page 88) about the synchronisation of wind generators needs more comment. The generators are induction generators, not synchronous generators.

If you take an ordinary induction motor and mechanically drive it faster than synchronous speed (eg, over 1500 RPM for a 4-pole machine), it will generate power back into the mains because the slip changes from around -4% to something in the positive direction. A normal motor is called a squirrel cage motor because the rotor consists of a number of bars joined at each end to form something that might look like a cage where a squirrel may run around endlessly (if the iron core was removed).

A wound rotor motor has the rotor bars taken out to slip rings so that additional resistance may be added in series for increased starting torque and then usually short circuited when the motor is up to full speed.

A wind generator is constructed along the same lines as the wound rotor but is called a Doubly-Fed Electric Machine. The stator frequency will be at mains frequency but this is also connected to a converter which feeds power back into the rotor at an appropriate voltage and frequency such that the slip frequency is appropriate to the output into the mains. The machine can provide an output within a rotor speed variation of ±30% of the nominal synchronous speed, therefore the windmill does not have to rotate at a steady speed to produce power into the mains.

When it is turning faster than synchronous speed the rotor is providing energy to the mains via the converter, which is combined with that coming from the stator. When turning slower than synchronous speed, the direction of energy flow through the converter reverses and hence the output from the wind turbine is less, which is what you would expect.

Note that such wind generators cannot generate any voltage until they are connected to the grid.

Alex Brown,
Ashburton, Vic.

Smart meter leads to savings on energy bill

Your editorial on smart power meters in the October 2008 issue is alarmist. We had a smart meter installed a couple of years ago and now save about $200.00 a quarter because of it. Our bill used to be about $600.00 and now is around the $400.00 mark.

We don't have an air-conditioner or electric hot water but we do have a few computers in the house that run a lot. I also work from home with usually a few TVs and other gadgets running on test. We also have a pool with the pumps running about four hours a day.

The savings were achieved by rearranging a few things, such as running the pool pump off-peak, running the dishwasher off-peak (it automatically comes on at 10PM with a timer), running the washing machine before 7AM and shutting down a few other non-essentials that do not need to run in peak time.

I think if we had done nothing, our bill would not have changed substantially or gone up slightly. The smart power meter gives us the option of running things at an off-peak tariff which would otherwise not be possible, since off-peak rates were previously only available on hot water systems (as far as I am aware).

Horst Leykam,
Dee Why, NSW.

Smart meter increases the energy bill

About a year ago, Energy Australia installed a Smart Meter at our house and didn't give me the option to refuse it! I currently receive a discounted rate, having both gas and electricity with Energy Australia.

We have reluctantly learnt to cope. If there is a stinking hot day coming up, the air-conditioning is on from 6AM to 2PM. The same applies if it is going to be freezing cold, with more reliance on gas heating as well.

If I was living in one of the less temperate areas of Sydney with an uninsulated house and was of more advanced years and in worse health, I doubt if such measures would be adequate!

My last Energy Australia bill (July 2008) was $233.15 for the quarter for both gas & electricity and was substantially more than before the change of meter.

Bob Yorston, VK2CAN,
Roseville, NSW. SC

Wind generators are not synchronised

I wish to comment on the question about wind generators being synchronised to the grid (Ask SILICON CHIP, September 2008, page 88). A couple of years ago I was part of a guided tour over the Woolnorth wind farm site in Tasmania. Since this was a tour for various engineering professionals we got to see and hear a bit more than usual about the entire project from the start to the finish.

I too asked the question "how are the different rotor speeds synchronised?"

The answer was that it isn't. In this case, the power generated at each individual tower is 600V DC (or thereabouts) and is electronically converted to synchronised AC and I think left the Farm about 10kV.

This explains quite clearly why the individual wind generators are all running at different speeds. We were also enthralled by the effect of a wind direction change while we were there as the controlling electronics turned the nacelles to fully face the new wind direction - a fascinating sight!

John Hardisty,
Burnie, Tas.

Australia's Lowest Priced DSO!

Now you've got no excuse ... update your old analogue scopes!

Whether you're a hobbyist, TAFE college or university workshop, the GW GDS-1022 has the price and performance for you.

GW GDS-1022 25MHz

- 25MHz Bandwidth, 2 Ch
- 250MS/s Real Time Sampling
- 4k Memory Per Channel
- TFT Colour Display
- 19 Auto Measurements
- Built-in USB & SD Card Slot
- **GW Brand - 28 years in Australia**

ONLY $549 inc GST

Sydney Tel 02 9519 3933 Fax 02 9550 1378
Melbourne Tel 03 9889 0427 Fax 03 9889 0715
Brisbane Tel 07 3275 2183 Fax 07 3275 2196
Adelaide Tel 08 8363 5733 Fax 08 83635799
Perth Tel 08 9361 4200 Fax 08 9361 4300
email testinst@emona.com.au
web www.emona.com.au

EMONA

Ever wanted to be an air traffic controller? This will let you experience it all – from the comfort of your PC!

AirNav RadarBox

by Ross Tester

We get to see a fair amount of new software and hardware here at SILICON CHIP. Most of it is pretty ho-hum – in many cases a new way to re-invent the wheel.

Every now and then, though, something comes along that leaves us open-mouthed. Gobsmacked, even.

For example, Google Earth (and its latest variant, Google Streetview) was/is such a program. I don't know about you but I still find the sheer concept of it absolutely amazing.

Well, now there's another piece of software (or more correctly, software **and** hardware) which has left all of us here saying "WOW!" (capital letters intended!).

It's called AirNav RadarBox

As the package says, it's the closest you can be to real world aviation without leaving your computer chair. If you are at all interested in aviation (and even if you're not!) we're sure you will agree with our first reaction. WOW!

Let's see if we can paint a picture for you.

We'll imagine great-aunt Mabel is flying from her home in the far north of Scotland to sunny Sydney to spend some time with you. She's sent you her itinerary, telling you each of the flights she's catching: from her home town of Wick to Edinburgh on RyanAir, from Edinburgh to London (Heathrow) on British Airways then from London to Australia on Qantas via the Kangaroo Route of Bahrain, Singapore and Sydney.

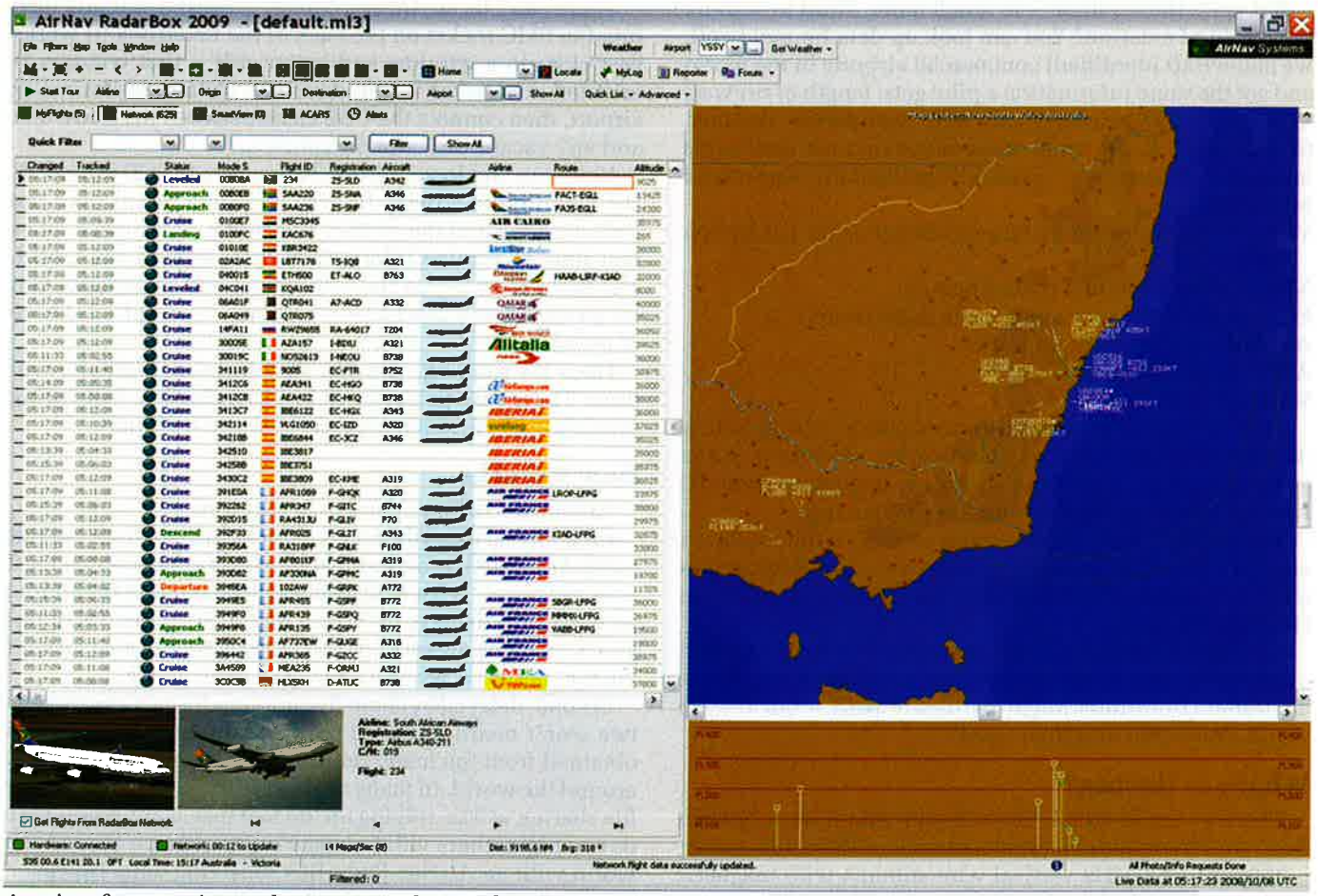
Of course, you can see from her itinerary (or by looking it up on the web) the (hopeful?) departure and arrival times of each flight.

But with the AirNav RadarBox and your PC, you can see so much more. You can "track" great-aunt Mabel all the way, knowing precisely where she is at any time.

You can "zoom in" on any or all of these airports and see each flight's progress on a "radar" screen, with virtually all of the information an air traffic controller at each of those locations: its exact location, the aircraft identification, aircraft type (even, in most cases, with a photograph or two of the actual aircraft, not just an aircraft of the same type), its heading, height, rate of climb or descent. . . just about everything.

Click on any of the airports along the way and you can follow great-aunt Mabel's progress all the way! Or you can store great-aunt Mabel's flight details and AirNav RadarBox will alert you when it finds the flight.

You'll even know that great-aunt Mabel's flight is running late (or early) as it approaches Sydney, probably even before the Captain has told great-aunt Mabel and the other passengers – so you could delay your journey to Sydney International Airport until the last minute and therefore avoid the huge parking charges!



A quiet afternoon in south-east Australia, as shown by the screen at right. Perhaps this is more a limitation of the antenna's field of view, being somewhat blocked in the direction of Sydney airport. Compare that with the screen of London Heathrow on the laptop opposite – and again, this was a relatively quiet time!

Inside the AirNav RadarBox receiver and signal processor. Actual box size is 125 x 105 x 20mm.

Impressed? We were! But how much more impressed would you be if we told you that you could do this from almost any location in the world?

But wait, there's more – so much more. Want to explore the world of aviation? You can look up data for any (well, we believe all identified) commercial airports in the world and get the same information a pilot gets: length of runway, VOR, NDB, FIX, airways and ATC boundaries, weather. (If you don't know what those abbreviations and terms mean, you'll learn very quickly!) Incidentally, they stand for/mean:

VOR – VHF omni range (ground-based radio navigation aid);
NDB – non-directional (radio) beacon,
FIX – position of an aircraft on its flight route;
Airway – approved flight route;
ATC – air traffic control.
Weather? Ummm . . .

There's also more than a million map locations including detailed shore lines, country boundaries, elevations, roads and much more. A 3D, multi-window display on your PC lets you select multiple features at the one time.

We found looking at the "radar screen" window for an airport like Sydney fascinating. Then we changed to airports such as London Heathrow, Chicago O'Hare and Atlanta Hartsfield-Jackson.

As three of the busiest airports in the world, the amount of air traffic around them was simply unbelievable. Those air traffic controllers might be highly paid – but they're worth every cent and then some!

What's in the box?

There's a small (105 x 125 x 22mm) aluminium "RadarBox" which contains all the electronics, a USB cable, a short (~300mm) 1090MHz vertical wire antenna with magnetic base and ground-plane baseplate plus a CD containing the RadarBox Software.

There is no power supply, because none is needed – RadarBox gets its power via the USB interface.

Setting up the AirNav

There can't be anything simpler: plug the antenna lead into the SMC socket on the back of the RadarBox (it works best close to a window and better still if that window is oriented somewhat in the direction of the nearest major airport, then connect the USB cable between the RadarBox and any vacant USB slot on your PC.

Next, run and install the software from the CD provided. We found quite a delay (maybe a minute or so) from the time we activated the AirNav RadarBox – perhaps it takes that time to receive information from around the world. The first time you run the software, it will interrogate you for password and username which will be supplied at time of purchase

Once it's running, you can start tracking flights in real time! There's no power switch; the RadarBox will spring into life as soon as it's plugged in to the USB port.

How it works

AirNav RadarBox operates in two ways.

First, in real time, the receiver picks up data from aircraft using ADS-B (Automatic dependent surveillance-broadcast – see the panel "what is ADS-B") within range of the simple antenna and displays their data on the PC screen. Without you even being aware of it, this information is also relayed via the 'net to all other AirNav RadarBox users.

Second, delayed by about five minutes for security reasons (we won't mention the "T" word) similar information is obtained from the many thousands of AirNav RadarBoxes around the world. In many ways, it's similar to peer-to-peer file sharing works, relying on the fact that at any time of the day or night, there will be many computers on around the world with an AirNav RadarBox receiving data. However, it doesn't rely on a connection to another computer; instead all data is sent to a central AirNav server.

After being processed and passing some validation algo-

What is ADS-B?

As we explained, the AirNav RadarBox relies on commercial aircraft transmitting an ADS-B signal. But what is ADS-B and how does it work?

First, to set the record straight, it has nothing whatsoever to do with ADSL as applies to broadband – it's an unfortunate coincidence of acronyms. ADS-B, which stands for Automatic Dependent Surveillance-Broadcast, is a form of air navigation assistance and safety aid for both pilots and air traffic controllers – and now anyone with a suitable receiver and software.

It is similar to the Automatic Identification System (AIS) now becoming widely used in commercial shipping.

Unlike conventional radar, ADS-B can also work at low altitudes and on the ground, so that it can be used to monitor traffic on the taxiways and runways of an airport. It's also effective in remote areas or in mountainous terrain where there is no radar coverage, or where radar coverage is limited.

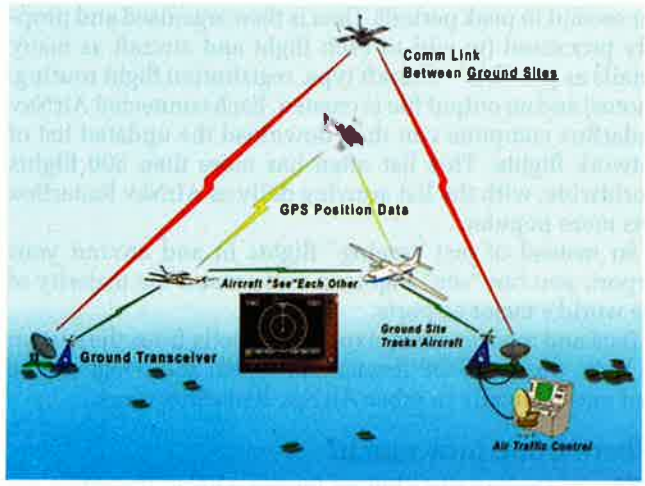
One of the greatest benefits of ADS-B is its ability to provide the same real-time information to both pilots in aircraft cockpits and ground controllers, so that for the first time, they can both "see" the same data.

Unlike an aircraft transponder, which transmits its aircraft identification when it receives a radio (or more usually radar) signal, the ADS-B transmits its information via a 1090MHz digital data link without any prompting – and often (ADS-B data is updated several times per second).

Furthermore, it works out its own positional information, speed, altitude, etc, to a large degree independently of the aircraft navigation system, from the GPS (global positioning system) satellite signals which we are all becoming very much more familiar with, given the plethora of GPS receivers now on the market.

Given the fact that GPS is now routinely accurate to just a couple of metres or so – and in aircraft, flying closer to the satellites without any obstructions, this accuracy would be at its maximum – ADS-B data is very accurate indeed.

Garmin GLD 90 Data Link Sensor and GPS antenna.



ADS-B offers increased, timely information for both pilots and air traffic controllers, increasing safety for all aircraft. (Courtesy ADS-B Technologies LLC).

An important factor is that this data is transmitted without any interaction by the pilot or crew – in fact, in an ADS-B system the crew has no input whatsoever.

Pilots in the cockpit see the traffic on a Cockpit Display of Traffic Information (CDTI). Controllers on the ground can see the ADS-B targets on their regular traffic display screen, along with other radar targets.

ADS-B provides traffic information to pilots that, until now, has unavailable to them. Because the system has an effective range of more than 150 miles, ADS-B provides a much greater margin in which to implement conflict detection and resolution than is available with any other system.

Pilots and controllers using ADS-B data will be able to determine not only the position of conflicting traffic, but will clearly see the aircraft's direction, speed, and relative altitude. As the conflicting aircraft turns, accelerates, climbs, or descends, ADS-B will indicate the changes clearly and immediately.

A plane equipped with ADS-B can theoretically fly closer to other aircraft because the locating data is more accurate and more real-time. Therefore the controller does not have to factor in as much of a margin for error.

Its name comes from its components: it's **Automatic** – It's always on and requires no operator intervention; it's **Dependent** – it depends on an accurate GPS signal for position data; it provides "radar-like" **Surveillance** services; and it continually **Broadcasts** aircraft position and other data to any aircraft, or ground station equipped to receive ADS-B.

There are 57 ADS-B receivers at 28 ground stations around Australia. Indeed, Australia (along with the US) was the first country to trial and later implement ADS-B.

There is considerable discussion (argument?) at the moment about ADS-B being extended to GA (General Aviation) aircraft; the most telling argument is the cost (around $10,000 plus installation) and annual maintenance for the private aircraft owner.

rithms the data is stored on a queue for server upload. This is where the five-minute delay is built in.

The AirNav server processes up to 10,000 flight messages per second in peak periods. Data is then organised and properly processed (to add to each flight and aircraft as many details as possible – aircraft type, registration flight routing, photos) and an output file is created. Each connected AirNav RadarBox computer can then download the updated list of network flights. This list often has more than 500 flights worldwide, with the list growing daily as AirNav RadarBox gets more popular.

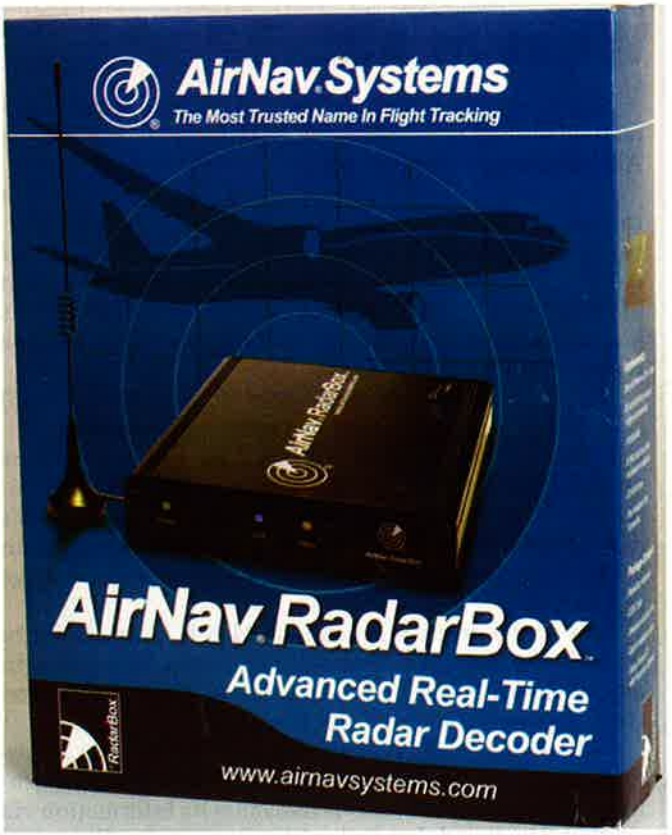
So instead of just "seeing" flights in and around your airport, you can "see" flights in and around the majority of the world's major airports.

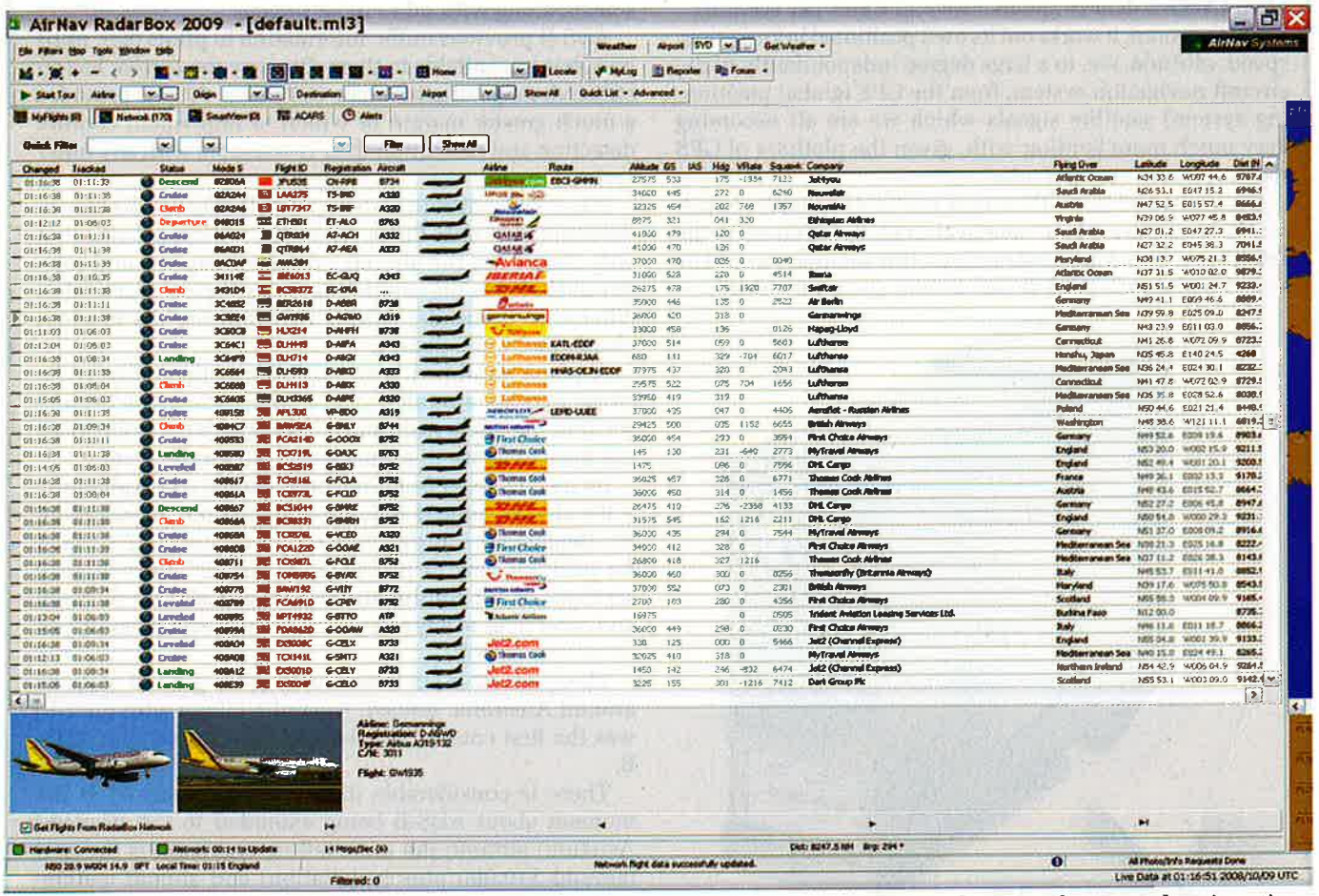
Data and reports can be exported directly from the system in XML, text and PDF format and screen shots/logs can be sent automatically to other AirNav RadarBox users.

Where from, how much?

The Australian distributors for the AirNav RadarBox are Hometech Consulting, PO Box 2110, Wattletree Road LPO, East Malvern, Vic 3145 (email jparncutt@bigpond.net.au).

At the time of going to press, (early October), the Australian dollar was in meltdown which made quoting a firm price rather difficult (in just one day the dollar had depreciated more than 4c!). However, Hometech's John Parncutt told us that he would try to hold the price at $990 for as long as possible, assuming the dollar stayed somewhere close to its current level. SC





There's an enormous amount of information presented on each flight, from its status, ID, the aircraft type and registration, airline, altitude, heading, vertical rate, squawk, the company flying, where it is at the moment . . . and much more!

10 watts off grid? A little can now go a L-O-N-G way!

We look at Jaycar's new "Sun in a Box" CIG Solar Lighting kit

by Stan Swan

Going bush? Living on a desert island/houseboat/mountain top? Sick of energy bills? Daily supply charges driving you crazy? Want to run extra wiring for decent shed lights but find that's illegal? Even considering DIY by running a backyard generator instead? Read on – "CIGnificant" solar help may be at hand!

Portable 230V/12V petrol & diesel off-grid generators have long been popular, with cheap (~$1 per watt or less) offerings in most hardware stores.

Aside from their use by farmers and tradesmen, in many remote regions the evening hum of the lighting generator is still almost as ubiquitous as a campfire.

However, generator storage and maintenance hassles, noise, fumes (and of course the need to purchase, deliver and store costly fuel) mean TCO (total cost of ownership) of off-grid systems are increasingly expensive.

Generator economics, even with remote regions facing fuel costs approaching $2 a litre, may seem "good value" and convenient against mains electricity at up to 20 cents per kW h "unit" (and more – see last month's "Publisher's Letter"). But are they good value?

Each litre of petrol has a calorific value of around 36MJ (diesel is slightly higher but most small generators are petrol-driven). As 1kWh = 3.6MJ (1000x60x60), this means a litre of petrol equates to some ten electrical units. With even the best fossil fuel generators only about 40% efficient in utilising this energy (most being wasted as heat), the electricity generated equates to a more costly 50 cents per kWh. Fuel storage and security, generator maintenance and eventual generator replacement need factoring in as well.

In the Australian outback, the vast Pacific expanses and in "off the beaten track" New Zealand, a generator may still be crucial for running power tools and refrigeration. But for modest lighting and perhaps battery charging needs, it increasingly makes no sense to inefficiently use fossil fuels when alternatives abound.

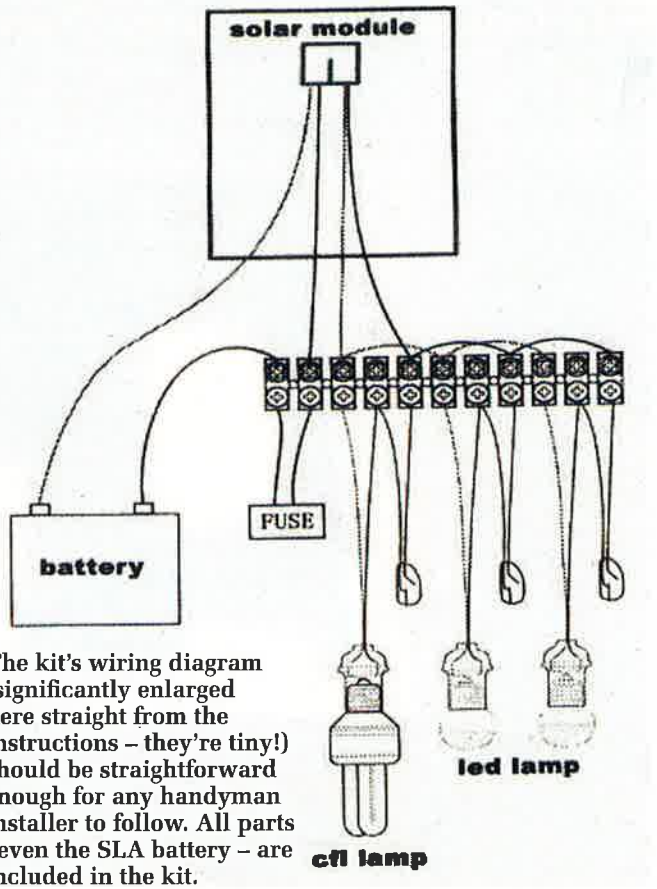
Fossil fuel lighting is now so costly for many subsistence Pacific and Asian communities that evening reading and learning is seriously threatened. Sailing vessels, especially, need to conserve fuel for emergencies, rather than frittering it away running on board electronics and cabin lights.

Energy out of thin air

Lighting alternatives? As this is a state-of-the-art electronics journal, we're not talking wax candles and kerosene lamps (although soaring fuel cost have tragically meant increasing burns and dwelling fires from these), since small photovoltaic (PV) systems now abound.

That's right – energy straight from the maker, with no middlemen, almost every day! Although now almost disdained

The Jaycar MP-4552 CIS self-contained solar lighting system is a much better proposition. It's much lighter, MUCH cheaper to run (energy from the sun is free until the Government works out a way to tax it!). With care, the supplied battery will last for years and even then they aren't too expensive to replace. We're very impressed with the CIS solar side of the kit; it's a pity that it is somewhat let down by poor-quality lighting fittings. Still, these are replaceable at relatively low cost!



The kit's wiring diagram (significantly enlarged here straight from the instructions – they're tiny!) should be straightforward enough for any handyman installer to follow. All parts –even the SLA battery – are included in the kit.

at the garden lamp level, you really couldn't want a better energy technology than PVs, as they're reliable, unobtrusive, have no moving parts and offer at least a 20-year life. You'd be lucky to get 10 years from a petrol generator!

Thanks to today's efficient and bright white LEDs, even a few stored watts can now go a long way in pitch black conditions.

A few watts? I've seen some Nepalese homes wired up at just 1W per household! It's fitting that the very parts of the off-grid world most in need of lighting, such as Africa, are often those with abundant sunshine.

Solar charging of cell phones and modest laptops, such as the ~6W models used in the OLPC (One Laptop Per Child) project, is also possible. It's not widely appreciated that even polar and mountainous regions can use PVs, as their sunshine (although at low angle) is captured more efficiently when panels are cooler and the air is likely to be more clear as well.

Compact solar panel prices in the ~10W range have fallen over the years to an attractive ~ $10 a watt, with larger 100W types around half this.

However, in some ways PVs have been almost too much of a recent success story. Manufacture of the commonest mono & polycrystalline-silicon-based types is extremely complicated and costly and makers have been hard-pressed to ramp up for surging demand.

Although silicon is the most abundant element on earth (sand being silicon dioxide), the refining needed for precision semiconductor work involves high temperatures and painstaking processes, with daunting setup costs and timeframes. It's not quite as simple as just waving a blow torch over a pile of sand!

"CIGS" you can light up indoors!

It's long been known that many other materials, such as Cadmium-Telluride (CdTe), show photovoltaic action but one of the most promising recently has been a brew of Copper, Indium and (di)Selenide (thus "CIS").

CIS PVs typically show energy conversion efficiencies of 10%, with enhanced "CIGS" types, (the G being Gallium, Ga) now reaching 19%!

Although not yet as efficient as the best silicon-based panels, rugged CIS types are much cheaper to make and offer superior low light performance – an important feature in the hazy and overcast conditions besetting much of the world.

Unlike cheap amorphous Si panels, with efficiencies typically only 5% and with output decreasing over time, CIS performance seems to actually improve with age – fine wine style.

Manufacturers already eagerly adopting this CIS/CIGS approach include Honda (using a glass based process – others focus on flexible films), with investments from even silicon semiconductor giant Intel – "An Intel in every PV" perhaps?

Many Asian makers have arisen but the CIS/CIGS market is presently dominated by Global Solar Energy (GSE) in Arizona, USA.

Jaycar's "Sun in a box"

Although still very much leading edge, a 10W CIS panel is now retailing locally as part of Jaycar Electronics' Self Contained Solar Lighting System – the Sun in a Box (Cat No MP-4552).

This looks very timely indeed for all manner of modest DIY installations. This sub-$200 kit includes everything needed, including the solar panel itself, CFL and LED lamps, bases, fuses, switch, wire, a screwdriver and a standard 12V 8Ah SLA battery) to set up a convenient turn-key 12V off-grid system.

A large part of the kit's appeal may arise from its ease of carrying (underarm!) into remote regions and its suitability for unskilled installation and servicing – a significant issue in

The 12V power socket on the developing countries' "One Laptop Per Child" (OLTP) project allows charging (and running) directly from the Jaycar kit's 10W CIS panel. In such applications, rather than sit around for hours in the blazing sun, it's probably better to first charge a cheap "jump start" 12V 7Ah battery and then bring that indoors to the laptop.

The lighting benefits of just 1W are readily apparent in this "available light" picture, with the kit's LED cluster near dazzling in comparison to the LED torch on the left.

many remote off-grid situations where licensed electricians may be in short supply but legally required.

But . . . only 10 watts?

Yes! 10W may seem trivial when spoilt by the sometimes kilowatts of lighting often found in homes today. (Don't believe us? Count the number of halogen downlights found in most modern homes. Twenty of them equals a kilowatt!)

However, the magnificent 12V 1W white LED clusters and 12V 5W CFL included in the kit dramatically transformed after-dark interiors and were found to especially suit such intensive activities as crafts, reading and cooking.

Although torches and headlamps can help when off-grid, many a candle-lit evening has lead to singed hair, clothing and papers, undercooked and spoilt food, or dramas when cooking oil is confused with kerosene, toothpaste with sun cream etc. Even a little light in the right place can literally save your bacon!

The CIS kit's panel includes a potted regulator which prevents both over discharge (harmful to any lead-acid battery) and excess charge.

The kit's directed LED clusters in fact seemed more useful than the "power hungry" glass CFL, which is easily accidentally damaged as well. Extra 12V white LED lamps could perhaps be instead added to suit and with the near trivial currents flowing, light duty wiring would suffice.

Retrofitting such cool-running LED clusters into gutted bulkhead or quality reading lamps also appeals, especially since traditional filament lamp heat dissipation issues no longer arise.

The kit's 10W CIS glass panel (in 2 x 48 strips), is made up of 2 x 5W in parallel (thus giving some leeway against shadows and breakage) and incorporates an inbuilt 3A regulator (itself worth perhaps $30). This regulator prevents battery overcharge and also provides an 11.2V low-voltage battery disconnect. No lead-acid battery should be allowed to fall below this voltage of course, as plate sulphation then sets in. A recessed tri-colour LED shows (undocumented) activity and status – naturally this LED would be more informative if front or externally mounted (and if it was explained!).

Performance

The Jaycar CIS panel performance itself was excellent and even in sunny mid-winter New Zealand the setup pushed 0.69A into the partially charged 12V SLA – significantly exceeding the stated 0.58A I_{PM} (maximum power current) rating.

Heavily overcast skies with light rain still gave around 90mA, which compared very favourably with 100mA from a 20W polycrystalline silicon panel, confirming good low-light and low-angle performance of CIS/CIGS.

Interestingly, the above overcast CIS PV output fell dramatically when placed behind window glass (which of course absorbs near-infrared wavelengths), verifying that the IR resource (normally "wasted" by Si PVs) is well utilised by CIS when outdoors.

Kit features

As the kit may appeal to the technically unskilled enthusiast for installation in demanding remote situations, several points emerge – both positive and negative, no pun intended!

Eventually, we knew there's be a use for blown light bulbs: replace their contents with LEDs for low voltage systems! Be careful when breaking and removing the glass.

If there is *never* a possibility of mains voltage being applied (eg, because there isn't any mains!), such "repaired" 12V LED bulbs can be used in standard (mains-type) fittings .

Positive:

• The 10W CIS panel & regulator looks capable of being linked to a far larger capacity battery, since the supplied 12V 8Ah SLA would be fully charged in just a couple of sunny days.

Information to suit the likes of an off-grid weekender would be beneficial, as further SLAs (or even a car battery) could be paralleled for greater energy storage during the idle week.

12V 7-8Ah SLAs are a cheap global standard and it's often possible to scrounge slightly-used ones, free, from "mission critical" security firms. The extra battery capacity could then support heavier loads over a few days, with confidence that the system would recover during the week for delivery again the next weekend.

• It's typical with solar to assume a battery capacity at least three times the demand anyway, to take into account cloudy/rainy days, etc. As the setup stands, just one evening's use of all three lamps may drain the battery to shutoff levels – and if it rained the next day there'd be little prospect of a fresh charge.

• The inbuilt regulator can only handle 3A, but a 12V car accessory/socket (Jaycar PP-1993 & PS-2003 etc) directly connected to the battery would allow short-term use of more demanding loads.

A 12V to 230V converter, such as Jaycar's can-sized 150W MI-5121, could even be directly connected to charge the likes of cordless power tools, laptops, cell phones, cordless toothbrushes and shavers. Being off grid doesn't mean you have to rough it – but leave the 2kW hair drier and electric frypan at home!

• A starter/power-pack (such the Jaycar MB-3596) could also be given a trickle charge, maybe then allowing jump-starting of a car (or boat) in a remote region. Such a need ranks amongst the most frustrating when in the wilds, as a flat vehicle battery (due to perhaps parking with a door ajar and an interior light left on) in rough terrain can make push starting impossible and be perhaps even life-threatening.

Negative:

• The single A4 instruction sheet enclosed should really be enlarged/expanded with clearer terminal and connection diagrams.

• We've commented in the past about the dangers of using low-voltage (ie 12V) lamps with normal 230V mains-type bases and the possibility of mixup. Unfortunately, all three provided 12V lamps are fitted with standard ES bases with sockets to match. While the CFL lamps are clearly labeled as 12V 5W, we believe it's only a matter of time before one of these is mistakenly used in a 230V lamp circuit – with spectacular, albeit brief, results. The more costly, gorgeous LED clusters are not even labelled, meaning that the chances are even higher that they'll be misused and destroyed.

• The supplied lamp sockets appear to be of mediocre quality, without polarity indications and they do not cleanly grip the base of the LED lamps. These may then annoyingly lose contact or even fall out! We would seriously consider replacing them.

• Despite our reservations about using mains-type fittings in a low-voltage system, if you were installing an off-grid low-voltage lighting system (where it was almost impossible that a mixup could occur), normal mains-type ES sockets could be used instead (albeit at extra cost).

These fittings would have the advantage of being suited to fitting into luminaires and lampshades normally used in a mains lighting system.

• A further benefit would be allowing your own LED clusters to be cheaply assembled, maybe as banks of three or four soldered in series inside an old (ES) lamp base. At last – a use for dead filament lamps!

• The three supplied line switches are rather too-light-duty for prolonged use and details regarding more convenient wall mounted fixed types should be included.

Conclusion

Although more costly than simple ~$40 "shed light" solar lighting systems, this "battery included" lighting kit looks great value and are especially suitable for modest off-grid users.

The CIS panel and LED lamps were outstandingly efficient performers; however, attention to the light socket quality and type should be of high priority to ensure both system reliability and prevent disastrous 12V/230V lamp mix ups.

Enhancement of the instruction sheets additionally could allow valuable off-grid charging applications, as it's apparent that these could offer applications well beyond the intended lighting. TAFEs and universities could find just the CIS PV itself appealing!

The Jaycar MP-4552 self-contained CIS Solar Lighting System is available from all Jaycar Electronics stores, dealers and on-line via www.jaycar.com.au. SC

DICK SMITH ELECTRONICS

www.dicksmith.com.au

EASY DIY INSTALL

BONUS WATCHGUARD REMOTE VALUED AT $55*1

$199
SAVE $50

Watchguard

Wireless Home Alarm System Easily arm or disarm your system via one of 2 included remote controls, includes 2 wireless PIR detectors, siren, backup battery, 10m of cable, control unit and power supply. L8048

INCREDIBLY LOW PRICE!

$139
SAVE $60

DICK SMITH

100W Professional Soldering Station Ideal for lead-free soldering, this solidly built station with all-metal chassis provides adjustable temperature from 200 - 450°C. Energy Saver circuitry, huge 100W power for fast heat-up and recovery, ESD safe design, maintains tip temperature within +/- 3°C, and includes a 1.6mm tip plus soldering iron holder. 2 year warranty. T2260

PRICE CRASH!

$8.99
SAVE $6

DICK SMITH

3.6V Rechargeable Cordless Screwdriver Adjustable angle (straight or pistol grip) with comfortable coated handle. Incl. chrome vanadium bits, forward/reverse direction switch, and AC charger. T4831

$29.99
SAVE $20

DSE

Large Aluminium Framed Tool Case Includes removable tool holder, 5 padded internal dividers, lockable latches with 2 keys, plus a strong carry handle. Approx. 456 x 326 x 148mm. Tools/accessories pictured not supplied. T4856

$39.99
SAVE $20

PRO-50K Butane Solderpro Kit Cordless, quick ignition, butane-powered soldering iron kit, includes 1mm soldering tip, hot knife, 'heat blower' and blow torch tips plus solder and a tip cleaning sponge. Incl. handy carry case. T1103

SAVE 50%! THIS MONTH ONLY

22¢/m
HALF PRICE

Light Duty Speaker Cable With 14 x 0.14mm conductors, this cable is ideal for intercoms, sensor line in alarm systems, short run audio connections and other indoor uses. W2010

SAVE 30%! NOVEMBER ONLY

$2.18/m
SAVE 30%

Low Loss OFC Speaker Cable Low loss OFC (oxygen free copper) speaker cable with a super flexible PVC sheath. Suitable for medium to high power installations – 168 conductors x 0.12mm. W2016

SAVE 30%! THIS MONTH ONLY

$1.10
SAVE 30%

75 Ohm TV Coaxial Cable RG-6 Quality shielded low loss coax preferred for less signal attenuation or longer cable lengths. W2084

$6.99
NEW

F59 Plug Solderless, Twin Pack F59 plugs with screw terminal suitable for analogue/digital TV, STBs and VCRs. P2091

*1 Via redemption. See in-store for details.

Promotion from 29/10/08 to 25/11/08

DICK SMITH ELECTRONICS

$79
SAVE $20

Lab Power Supply 13.8V DC 23A This solidly built switch-mode power supply provides well regulated 13.8V DC output with a 23A current rating. Highly RF resistant, it is ideal for powering transmitters and other high-current loads in engineering and servicing applications. Features include an internal thermally switched cooling fan, heavy-duty DC banana terminals, a strong metal case, and extensive overload protection. Q1755

$169
SAVE $100

Lab Power Supply 3-30V DC 20Amp This efficient switch-mode power supply provides adjustable 3V to 30V DC output, 20A maximum continuous current, low ripple and noise output, and a compact case with an integral cooling fan. A fixed 13.8V output switch can be selected to over-ride the front panel voltage selection, allowing simple powering of high power car audio and radio transmitting equipment. Features large LED front-panel metering and heavy-duty banana sockets. Q1765

$7.49
SAVE $7.50

3.5 Digit LCD Panel Meter 13mm LCD display, 200mV full scale input sensitivity and single 9V DC operation, high input impedance >100MOhm, easy bezel fixing method. Reading rate of 2-3 times per second. Q2220

$36.98
SAVE $20

3.5 Digit Auto Backlight Digital Multimeter A solidly built 3.5digit Multimeter with Auto backlit LCD screen, wide voltage and current measurement ranges, plus Frequency, Temperature and Capacitance measurements. Includes Test leads and K-type Temperature probe. Q1458

$98
SAVE $50

1000A AC/DC True RMS Digital Clamp Meter This industrial grade meter features a large 4000 count LCD screen plus bar graph display, AC/DC current ranges to 1000A, and Auto Power Off function. True RMS AC voltage and current readings provide greater accuracy when measuring non-sine waveforms. Q1476

$3.99
NEW!

Pack of 5 Solderless F59 Plugs F59 type solderless twist-on cable plug pack of 5. P2096

$3.88

F59 Plug to F59 Plug Joiner/ Adaptor Twin Pack A double-ended F59 Male Plug Adaptor for joining two F81 sockets or for gender changing an F81 socket into an F59 male plug. P6629

CLEARANCE LINE
NOT AVAILABLE IN ALL STORES

$3.81
SAVE $2.50

4PDT Miniature Toggle Switch 4-pole double changeover switch. Rating: 240V AC 3A. Mounting: Threaded bush. Overall Size: 22x13x34mm. Clearance: 14.5mm. Cut Out: 6.5mm. P7658

$4.88
SAVE $6

DPDT 10A Relay Heavy duty silver alloy plated contacts (30V DC, 240V AC rated), 12V coil, Double Pole Double Throw (double changeover switching contacts) relay. Full details online at: www.dicksmith.com.au P8014

*Conditions apply. See in-store for details. Terms and conditions: Offers start 29/10/08 and end 25/11/08 or while stocks last. No rainchecks. No layby. Offers may not be available in some reseller or franchise stores.

50 YEARS OF THE IN

It's hard to imagine a world without the integrated circuit, just as it is hard to imagine a manufactured product without one! But the IC has only been with us for half a century, being first demonstrated on September 12, 1958.

by Ross Tester

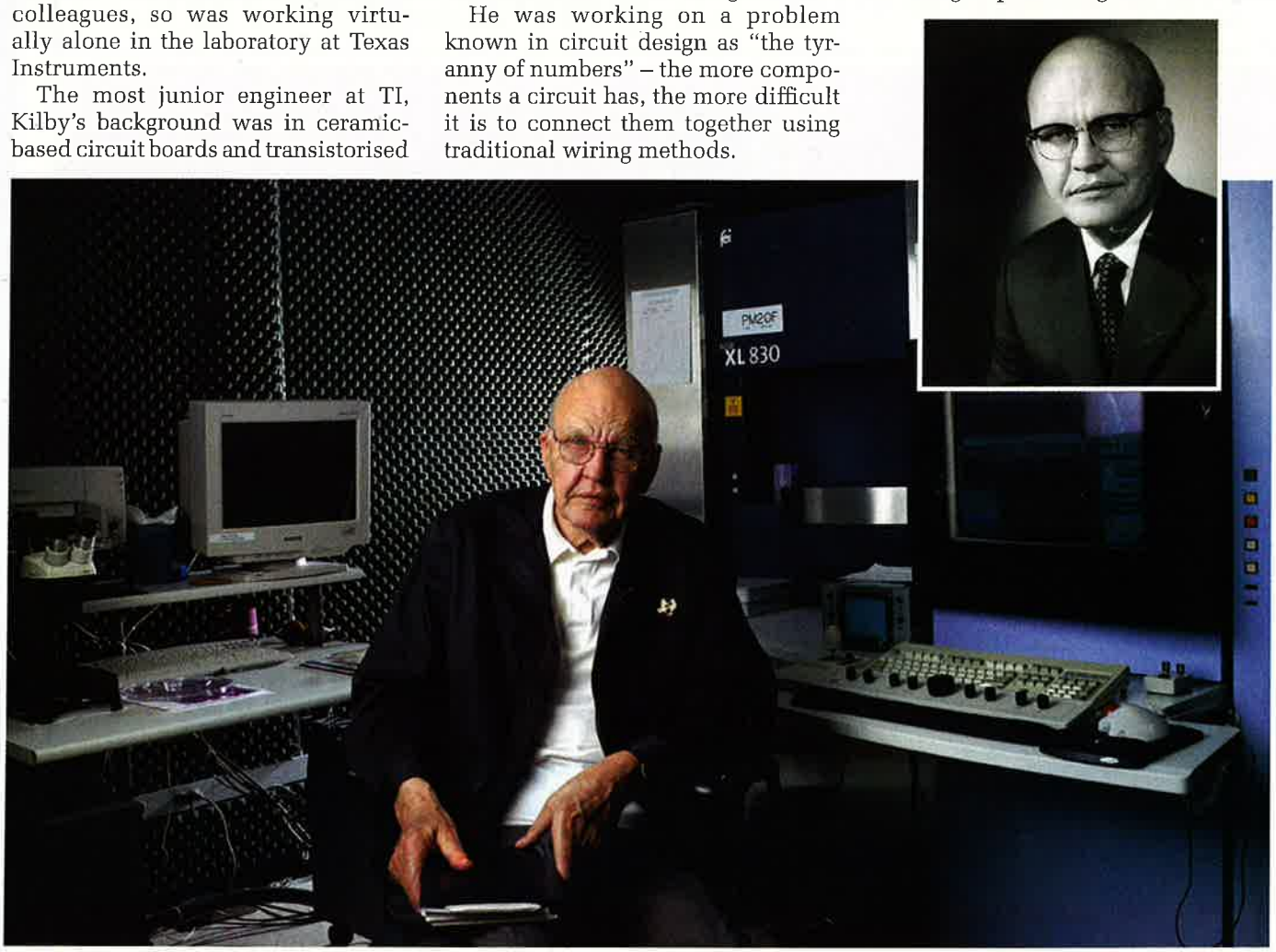
It was midsummer, 1958. Jack St Clair Kilby, a recently-employed 35-year-old engineer didn't have enough leave accrued to take the summer break off like most of his colleagues, so was working virtually alone in the laboratory at Texas Instruments.

The most junior engineer at TI, Kilby's background was in ceramic-based circuit boards and transistorised hearing aids. He joined TI because it was the only company that agreed to let him work on electronic component miniaturization more or less full time – and it turned out to be a great fit.

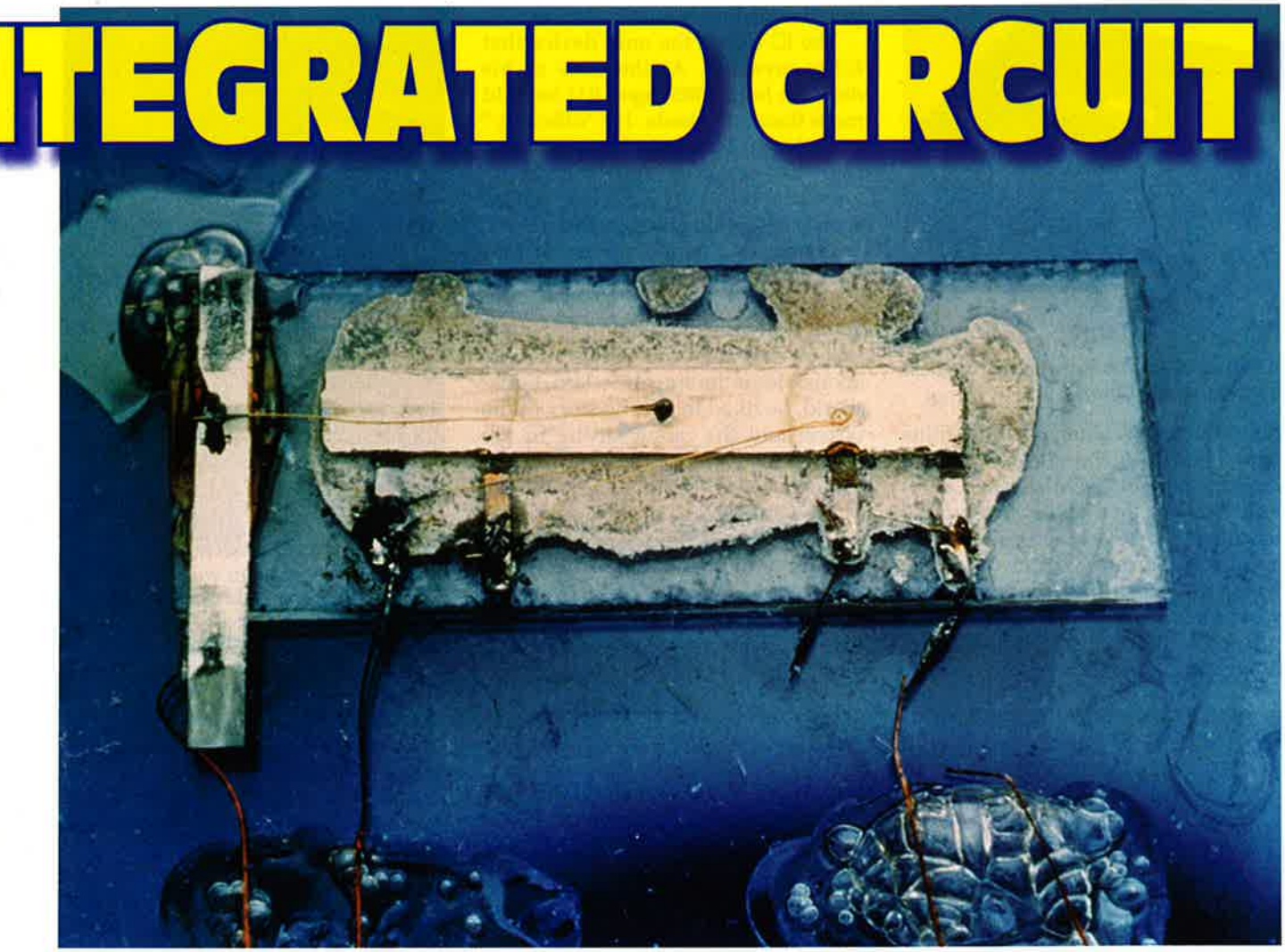
He was working on a problem known in circuit design as "the tyranny of numbers" – the more components a circuit has, the more difficult it is to connect them together using traditional wiring methods.

Kilby had come up with an ingenious solution: manufacturing all of the circuit components in a single piece semiconductor substrate.

Using a piece of germanium (the



Inventor (or co-inventor) of the integrated circuit, Jack St Clair Kilby, in the Texas Instruments laboratory in 2000, the same year he was awarded the Nobel Prize in Physics. Inset top right is Jack Kilby in 1958, the year of his invention. *(Pictures courtesy Texas Instruments)*



The world's first integrated circuit, September 12, 1958. *(Picture courtesy Texas Instruments)*

then-common semiconductor material) Kilby cobbled together a crude device in the TI laboratory and on September 12, 1958, he presented his findings to Texas Instrument management.

His germanium circuit was attached to an oscilloscope, which displayed a continuous sinewave, proving that the concept worked. Thus the integrated circuit was born, ushering in an era that even Jack Kilby couldn't possibly envisage.

"What we didn't realise then was that the integrated circuit would reduce the cost of electronic functions by a factor of a million to one, nothing had ever done that for anything before," said Jack Kilby

A patent application for "A solid circuit made of germanium" was filed on February 6, 1959.

Kilby was awarded the Nobel Prize in Physics in 2000 for "his part in the invention of the integrated circuit". He had always scoffed at the idea of such an honour, despite many people over the decades suggesting he deserved it – and despite him being awarded just about every other prize and honour available to a humble engineer; one who happened to change the course of history.

"Those big prizes are for the advancement of understanding," Kilby would explain in his slow, plain-spoken Kansas way. "They are for scientists, who are motivated by pure knowledge. But I'm an engineer. I'm motivated by a need to solve problems, to make something work. For guys like me, the prize is seeing a successful solution."

Unbeknownst to Kilby, at TI's great rival Fairchild Semiconductor, co-founder Robert Noyce was also working on a similar concept. Noyce's approach was different to Kilby's, using silicon as the substrate, rather than germanium and using aluminium as conducting strips. Noyce's patent application was filed on July 30 1959, more than five months after Kilby's.

As it happened, Noyce's approach was much easier to manufacture than Kilby's and for many years, Noyce claimed to be the inventor of the integrated circuit (as it came to be known), ignoring the fact that Kilby got there first. The first commercially-available integrated circuit was released by Fairchild in 1961.

After several years of legal battles, TI and Fairchild wisely decided to cross-license their technologies, creating a global market now worth about $1 trillion a year.

These days, both Kilby and Noyce are credited with the invention. In fact, Kilby's Nobel Prize acceptance speech more than forty years after the invention specifically highlighted Noyce's achievements.

"I would like to mention another right person at the right time, namely

Another of Kilby's inventions, the first handheld calculator.

Robert Noyce, a contemporary of mine who worked at Fairchild Semiconductor," he said. "While Robert and I followed our own paths, we worked hard together to achieve commercial acceptance for integrated circuits. If he were still living, I have no doubt we would have shared this prize."

Robert Noyce, incidentally, went on to found a small integrated circuit producer called Intel.

The IC wasn't the only device that Kilby invented. At the time of his death in June 2005 (aged 81) he held more than 60 patents. He "officially" retired from TI in 1980 but it has been said that he never really retired, always keeping a very close association with the now-huge organisation.

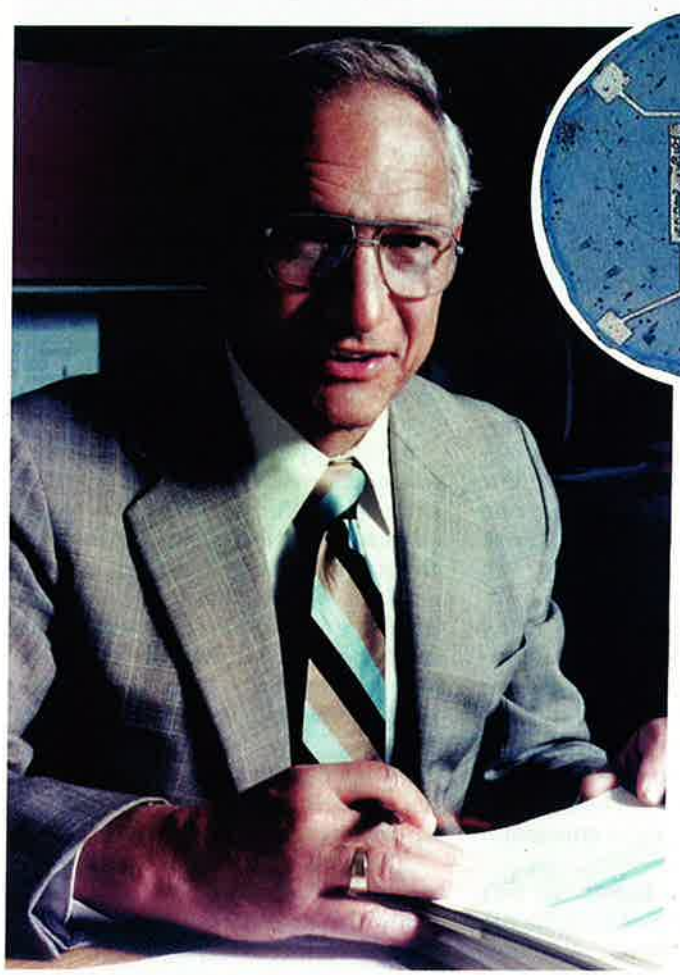
A giant of a man (over 2m or 6'6" tall), Kilby was not much for self-praise. "My part was pretty small, actually," he said. Whenever people would mention that Kilby was responsible for the entire modern digital world, he liked to tell the story of the beaver and the rabbit sitting in the woods near Hoover Dam. "Did you build that one?" the rabbit asked. "No, but it was based on an idea of mine," the beaver replied.

After proving that integrated circuits were possible, Kilby went on to head teams at TI that built the first military systems and the first computer incorporating integrated circuits. He also worked on teams that invented the handheld calculator and the thermal printer, which was used in portable data terminals.

A modern-day silicon wafer. This is more attributable to Noyce than Kilby but both are credited with the invention. *(Courtesy Texas Inst).*

But it is the integrated circuit which will always be associated with Jack Kilby.

As Tom Engibous, Chairman of Texas Instruments said, "In my opinion, there are only a handful of people whose works have truly transformed the world and the way we live in it – Henry Ford, Thomas Edison, the Wright Brothers and Jack Kilby. If there was ever a seminal invention that transformed not only our industry but our world, it was Jack's invention of the first integrated circuit." SC



Robert Noyce, today also credited with the "invention" of the integrated circuit, based his design on silicon, rather than the germanium of Jack Kilby. Inset at top is the first commercial IC to come out of Fairchild.

Handling wafers in today's ultra clean-room conditions achieves yields orders of magnitude higher than those in the early days of IC manufacture, where yields of 5% were considered good.

This photo shows one of the oxygen sensors (arrowed) used in a Holden VT Commodore. The VT's V6 engine has two such sensors – one for each cyclinder bank.

The 1997 Suzuki Vitara uses a 4-wire oxygen sensor – two for the heater, one for the signal and the other for ground. It's mounted on the exhaust manifold.

Narrowband & wideband oxygen sensors . . . how they work

By JOHN CLARKE

The oxygen sensor is an important component in your car's engine management system. It monitors the oxygen content in the car's exhaust, to indicate whether the mixture is too lean or too rich. Here's a quick rundown on how the two basic types work.

YOUR CAR engine's air/fuel ratio not only has a considerable bearing on its performance but also on fuel consumption and air pollution. If the mixture is too rich (ie, too much fuel), then fuel economy will suffer and the unburnt hydrocarbons will cause air pollution. Conversely, a lean mixture (ie, too much air) will give poor engine performance and produce more nitrous-oxide pollutants.

A lean mixture can also cause serious engine damage under certain circumstances, particularly at high RPM or under heavy loads.

To combat this, all modern cars use at least one exhaust gas oxygen (EGO) sensor which is mounted on the exhaust manifold. This monitors the resultant oxygen content in the exhaust and provides a voltage output which indicates whether the mixture is rich or lean or at the "stoichiometric" point (ie, when there is just sufficient oxygen in the air-fuel mixture to give complete combustion).

This information is fed to the engine management computer (ECU) which in turn controls the fuel injectors. It enables the ECU to continuously adjust the mixture to provide optimum power and economy, consistent with low exhaust emissions.

In addition, your car's catalytic converter has an important role to play in reducing emissions. This is also mounted in the exhaust system and converts combustion byproducts such as carbon monoxide (CO) to carbon dioxide (CO_2), unburnt hydrocarbons to CO_2 and H_2O (water) and nitrous oxide (NO) to nitrogen (N_2). Some cars include another EGO sensor after the catalytic converter, to monitor its performance.

In practice, a catalytic converter works best when the air/fuel mixture is kept within a narrow range close to the stoichiometric ratio. This ratio varies according to the fuel used but is generally 14.7:1 for unleaded petrol; ie, the air mass must be 14.7 times the fuel mass.

Lambda values

Another way of specifying the air/fuel ratio is by its "Lambda" (λ) value. Basically, the Lambda value is the actual air/fuel ratio divided by the stoichiometric ratio. This means that the Lambda value is 1 at the stoichiometric point, while lean air/fuel ratios have a Lambda greater than 1 and rich

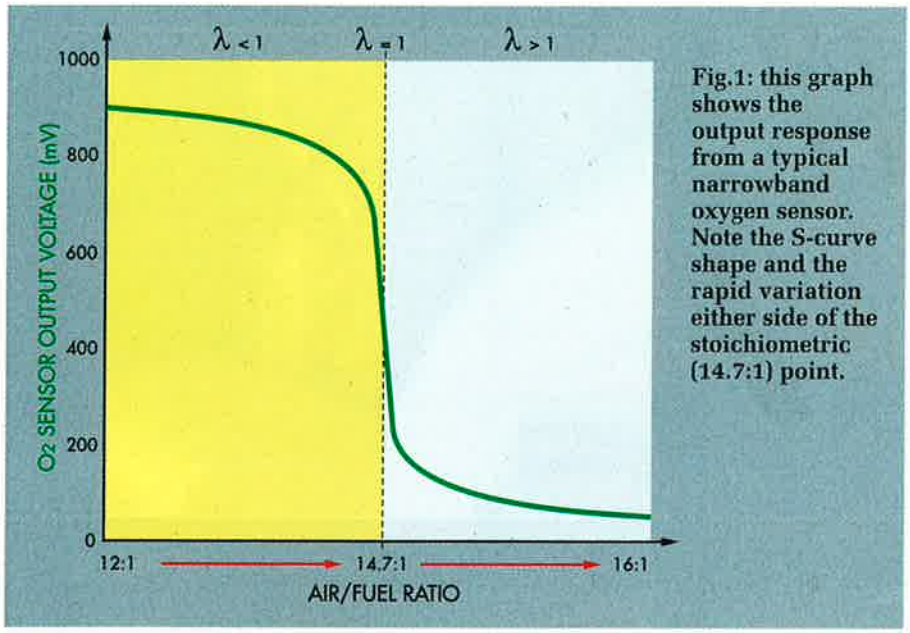


Fig.1: this graph shows the output response from a typical narrowband oxygen sensor. Note the S-curve shape and the rapid variation either side of the stoichiometric (14.7:1) point.

The Bosch LSU 4.2 wideband sensor is used in conjnction with a wideband controller (eg, the Innovate Motosports LC-1).

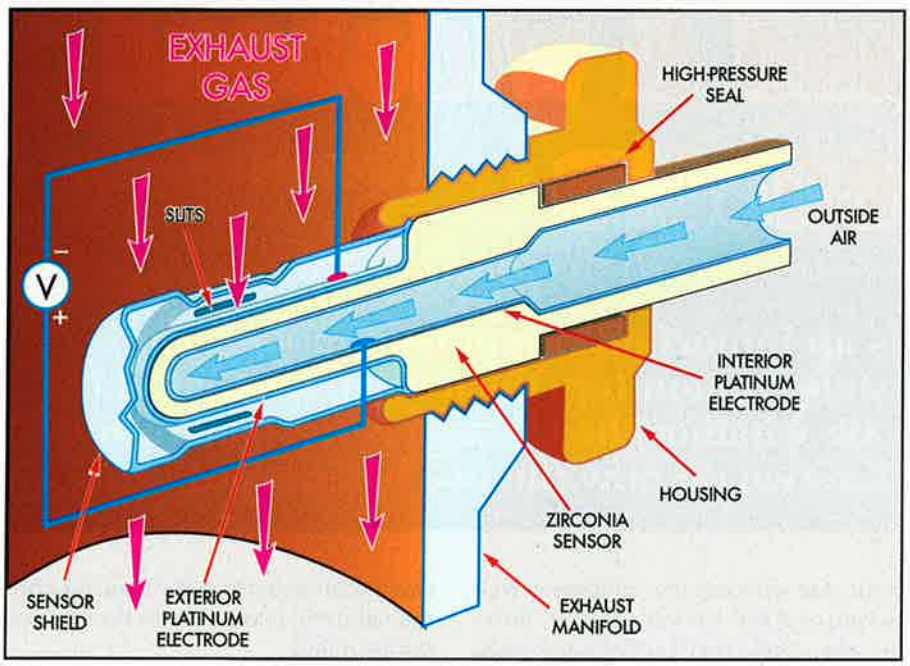


Fig.2: what's inside a narrowband zirconia oxygen sensor. It consists of a zirconia ceramic sensor element with thin platinum electrodes on both sides.

air/fuel ratios have a Lambda that's less than 1.

Narrowband sensors

Virtually all cars (with a few exceptions) are fitted with what a known as "narrowband" oxygen sensors. This type of sensor is generally only accurate around the stoichiometric point but that doesn't matter for use in a car engine since it is only required to indicate whether the mixture is rich or lean.

In operation, a typical narrowband oxygen sensor outputs a voltage ranging from just 0-0.9V. A stoichiometric measurement gives an output of 0.45V and varies sharply either side of stoichiometric. As a result, the sensor's output varies from about 0.2-0.8V over a very narrow band.

Fig.1 shows the output response from a typical narrowband zirconia oxygen sensor. Note the steep voltage changes about the stoichiometric point and the tapering off of the response at the rich and lean ends. This response is often referred to as an "S" curve.

The result is that for rich mixtures, the sensor varies from just 0.8V to 0.9V (ie, 100mV), while for lean mixtures the voltage range is usually less than 200mV.

Fig.2 shows how a narrowband zirconia oxygen sensor is made. It's typically about the same size as a spark plug and is threaded into the exhaust system so that the sensor is exposed to the exhaust gasses. The assembly is protected using a shield that includes slots so that the exhaust gasses can pass through into the sensor.

The sensor itself is made from a zirconia ceramic material that has a thin layer of porous platinum on both sides. These platinum coatings form electrodes to monitor the voltage produced by the zirconia sensor as the exhaust gas passes through it.

The device operates by measuring the difference in oxygen content between the exhaust gas and the outside air. The oxygen content of the air (about 21%) serves as the reference. In operation, a voltage is produced between the electrodes because the zirconia sensor has a high conductivity for oxygen ions at high temperatures.

Generally, the accuracy from this type of oxygen sensor at the rich and lean ends is poor and it cannot be relied on to give consistent air/fuel ratio readings. In fact, the accuracy at the rich end is particularly variable because it changes markedly with temperature.

To overcome this problem, some sensors include a resistive heating element to ensure that they operate within their correct temperature range. This reduces the errors under rich mixture conditions when the engine is cold. In addition, Bosch manufactures a sensor that is relatively accurate over a wider range of air/fuel ratios than other narrowband sensors. This is designated the LSU11 and is used in some air/fuel mixture display units but

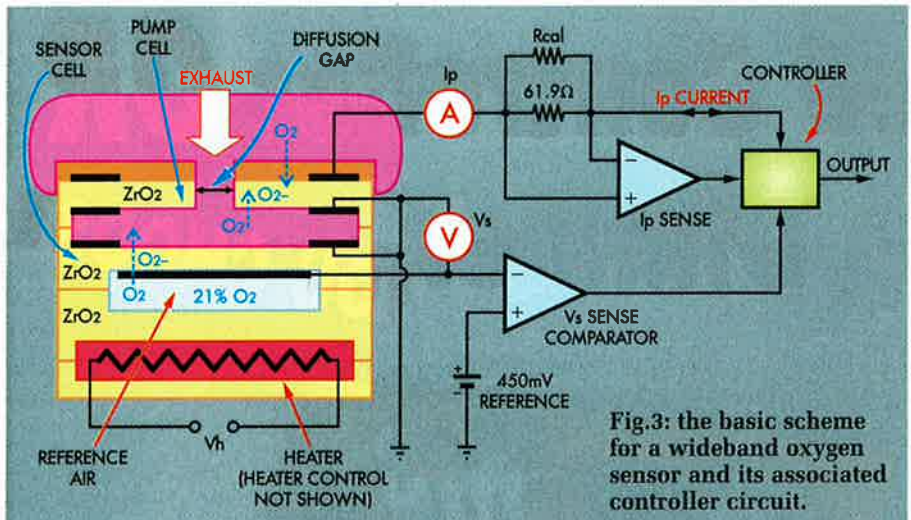


Fig.3: the basic scheme for a wideband oxygen sensor and its associated controller circuit.

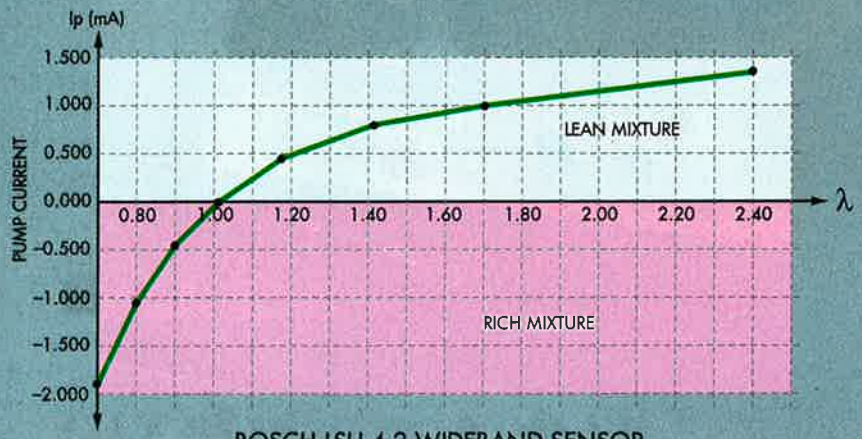


Fig.4: pump current vs lambda value for a typical wideband sensor. It's converted to a linear response by the wideband controller.

it is still a narrowband sensor.

The LSU11 is sometimes called a "wideband" sensor because it can provide a wider measurement of air/fuel ratio in the lean region than typical narrowband sensors. However, its response is still an "S" curve and its accuracy is still compromised beyond the stoichiometric region (ie, in the rich and lean regions).

Wideband sensor & controller

The wideband sensor and its associated controller circuit was developed in order to obtain an output that is far more linear with respect to air/fuel mixture. This not only gives much improved accuracy but this type of sensor also covers a wider range of values in the rich and lean regions.

The wideband sensor design is based on the narrowband zirconia oxygen sensor but includes a clever method to obtain a more linear response. It's based on the fact that the narrowband zirconia oxygen sensor is very good at detecting the stoichiometric mixture, ie, where there is no oxygen remaining after the combustion process and no excess unburnt fuel.

By adding an oxygen pump cell to the sensor, oxygen ions can be fed either into or out of the sensor so that it is always measuring at the stoichiometric point. This means that if the mixture is lean, then excess oxygen is detected by the oxygen sensor. The pump cell then drives oxygen ions out of the sensor until the stoichiometric point is reached.

Similarly, if the mixture is rich, oxygen ions are pumped into the sensor cell until a stoichiometric reading is obtained. As a result, the current applied to the pump cell can be either positive or negative, depending on whether oxygen is pumped into or out of the sensor cell.

Fig.3 shows the basic scheme. The voltage from the oxygen sensor cell is Vs, while the current into the pump cell is Ip. At stoichiometric, Vs is 450mV and this voltage is compared against a 450mV reference.

If Vs is higher than the 450mV reference, the mixture is rich and the Vs sense comparator output goes low. This "informs" the controller that Ip needs to go negative to pump oxygen ions into the sensor cell in order to regain a stoichiometric measurement. Note, however, that this oxygen pumping has no effect on the actual air/fuel ratio of the exhaust mixture. It only changes the sensor response.

Similarly, if Vs is lower than the 450mV reference, the exhaust mixture is lean and the comparator goes high. As a result, the controller changes the Ip current direction to pump oxygen out of the sensor cell.

In operation, the circuit is continuously controlled so that Vs is maintained at 450mV. The actual current required to maintain stoichiometric readings from the sensor cell is proportional to the air/fuel ratio.

Fig.4 plots current against lambda for a typical wideband sensor. Note that the current with respect to lambda is far more linear than the output of a narrowband sensor. The wideband controller converts this response into a 0-5V output that represents the air/fuel ratio as a linear scale.

Calibration resistor

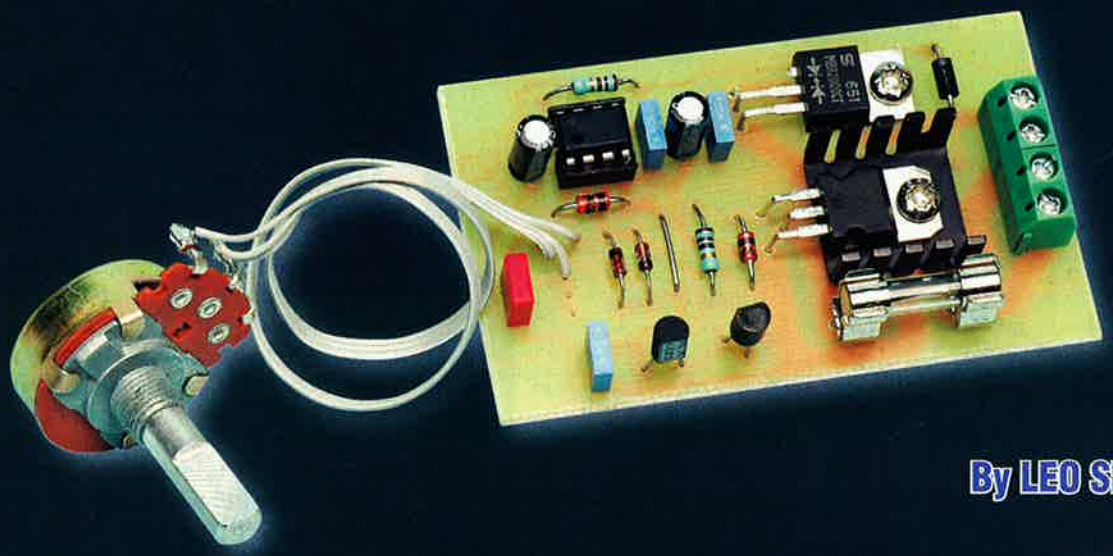
Note also that Ip is sensed by measuring the voltage across a 61.9Ω resistor that is also in parallel with a calibration resistor (R_{cal}) – see Fig.3. The R_{cal} resistor is adjusted in parallel with the 61.9Ω resistor during the manufacture of each wideband sensor so that the current versus lambda curve is accurate when connected to a controller, even if the sensor is replaced.

Apart from controlling the oxygen pump, the wideband controller also controls a heater element so that the sensor's temperature is maintained at a constant 750°C. In fact, the sensor doesn't provide accurate readings until this temperature is reached. The controller determines the sensor current by measuring the impedance of the sensor cell which is 80Ω at 750°C.

So that's basically how oxygen sensors work. Elsewhere in this issue, we describe a Wideband Oxygen Sensor Display unit, so that you can monitor the air/fuel ratio as you drive. You'll find it on page 58. SC

12V Speed Controller OR 12V Lamp Dimmer

YOU CHOOSE



By LEO SIMPSON

This handy circuit can be used as a speed controller for a 12V motor rated up to 5A (continuous) or as a dimmer for a 12V halogen or standard incandescent lamp rated up to 50W. It varies the power to the load (motor or lamp) using pulse width modulation (PWM) at a pulse frequency of around 220Hz.

SILICON CHIP has produced a number of DC speed controllers over the years, the most recent being our high-power 24V 40A design featured in the March & April 2008 issues. Another very popular design is our 12V/24V 20A design featured in the June 1997 issue and we have also featured a number of reversible 12V designs.

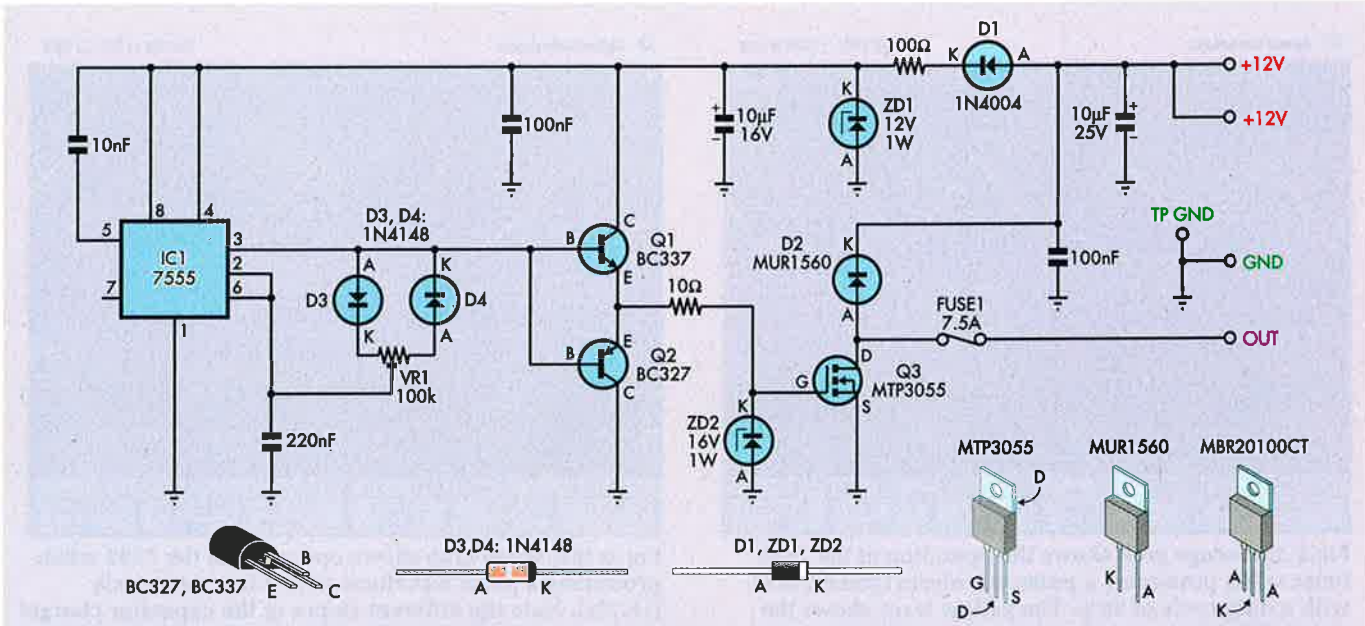
For many applications though, most of these designs are over-kill and a much simpler circuit will suffice. Which is why we are presenting this basic design which uses a 7555 timer IC, a Mosfet and not much else. Being a simple design, it does not monitor motor back-EMF to provide improved speed regulation and nor does it have any fancy overload protection apart from a fuse. However, it is a very efficient circuit and the kit cost is quite low.

There are many applications for this circuit which will all be based on 12V motors, fans or lamps. You can use it in cars, boats, and recreational vehicles, in model boats and model railways and so on. Want to control a 12V fan in a car, caravan or computer? This circuit will do it for you.

Halogen lamps

While the circuit can dim 12V halogen lamps, we should point out that dimming halogen lamps is very wasteful. In situations where you need dimmable 12V lamps, you will be much better off substituting 12V LED lamps which are now readily available in standard bayonet, miniature Edison screw (MES) and MR16 halogen bases. Not only are these LED replacement lamps much more efficient than halogen lamps, they do not get anywhere near as hot and will also last a great deal longer.

By the way, you can also use this circuit to control motors with higher current ratings, say up to 10A, but we add the proviso that if the motor is likely to be pulling currents at up to its maximum over long periods, then you may have to fit a bigger heatsink to the Mosfet. Normally such bigger motors will not pull their rated currents in most applications and the fact that you are using this circuit to reduce the speed (why else would you use it?) means that the current drain will



SC ©2008 12V SPEED CONTROLLER/DIMMER

Fig.1: the circuit uses a 7555 timer (IC1) to generate variable width pulses at about 210Hz. This drives Mosfet Q3 (via transistors Q1 & Q2) to control the speed of a motor or to dim an incandescent lamp.

automatically be reduced.

For most applications though, fit the specified 7.5A fuse. If you want higher current, fit a 10A fuse and use higher current leads to connect the unit to the battery and to the load.

Circuit description

The PWM control circuit is shown in Fig.1 and as already noted, it is based on a 7555 timer IC and a Mosfet. The timer is wired in an unusual way, with the normal timing components connected to pins 2, 6 & 7 omitted and substituted by a 100kΩ trimpot and two diodes which connect from the output at pin 3 to the timing inputs at pins 2 & 6. A 220nF capacitor from pins 2 & 6 to 0V completes the timing circuit while a 10nF capacitor is connected from pin 5 to 12V.

In this configuration the 7555 can be regarded as an astable oscillator based on a comparator. Instead of the timing capacitor being charged from the positive supply and discharged by pin 7, the 220nF capacitor is charged and discharged from pin 3 via diodes D3 & D4 and the 100kΩ trimpot.

It works like this: when power is first applied, pins 2 & 6 will be low and pin 3 will be high. The 220nF capacitor will then be charged from pin 3 via diode D3 and the resistance between the cathode (K) of diode D3 and the wiper of potentiometer VR1. When the voltage across the capacitor reaches 0.66Vcc (ie, about 7V), the output at pin 3 goes low and the capacitor will then be discharged via diode D4 and the resistance between diode D4's anode and VR1's wiper.

When the capacitor voltage drops to 0.33Vcc (ie, about 3.4V), the output at pin 3 goes high again and the 220nF capacitor will now be charged again, as before. This cycle then continues until power is removed from the circuit.

Parts List

1 PC board, code 05111081, 79 x 47mm
2 2-way PC-mount screw terminals
1 TO-220 mini heatsink, 19 x 19 x 10mm
2 M205 PC fuse clips
1 7.5A M205 fast blow fuse
1 M3 x 6mm screw
1M3 z 10mm screw
2 M3 nuts
1 50mm length of 0.8mm tinned copper wire (link)
1 100kΩ horizontal trimpot (VR1) OR
1 100kΩ linear potentiometer
1 1mm PC stake (for TP GND)

Semiconductors
1 7555 timer (IC1)
1 BC337 NPN transistor (Q1)
1 BC327 PNP transistor (Q2)
1 MTP3055 or higher rated Mosfet (Q3)
1 12V 1W zener diode (ZD1)
1 16V 1W zener diode (ZD2)
1 1N4004 1A diode (D1)
1 MUR1560 (or equivalent) 15A 600V fast recovery diode (D2)
2 1N4148 diodes (D3,D4)

Capacitors
2 10µF 16V PC electrolytics
1 220nF MKT polyester (code 224 or 220n)
2 100nF MKT polyester (code 104 or 100n)
1 10nF MKT polyester (code 103 or 10n)

Resistors (0.25W, 1%)
1 100Ω
1 10Ω

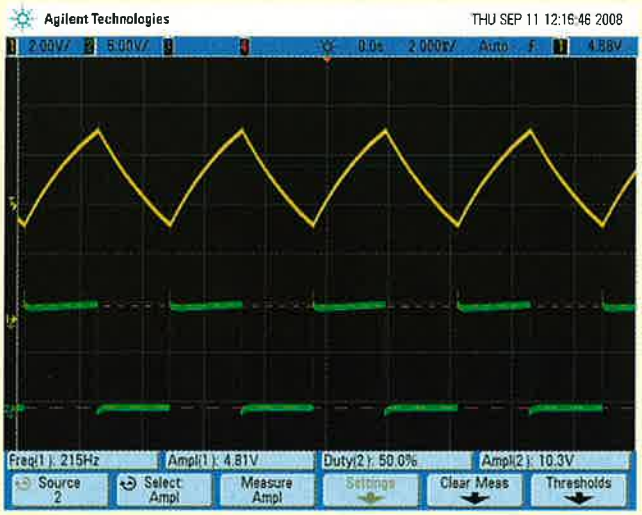


Fig.2: this scope grab shows the operation of the 7555 timer when producing a pulse waveform (green trace) with a duty cycle of 50%. The yellow trace shows the charge/discharge waveform across the timing capacitor.

Fig.3: this scope grab shows operation of the 7555 when producing a pulse waveform with a low duty cycle (16.7%). Note the different slopes of the capacitor charge/discharge waveform (yellow trace).

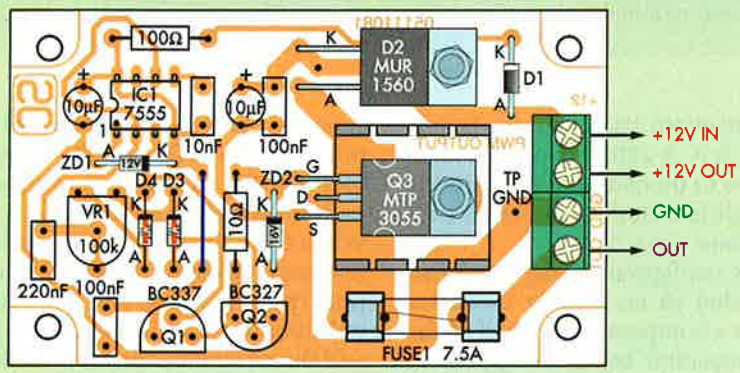
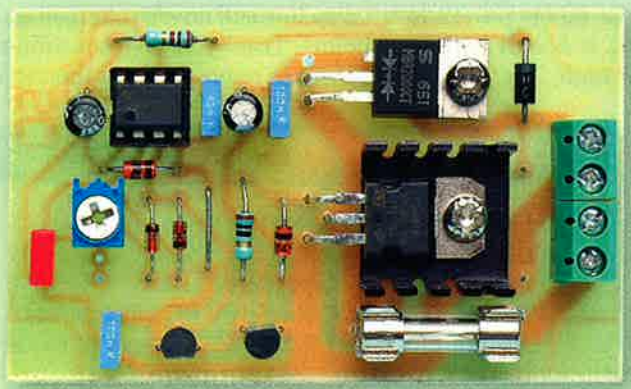


Fig.6: install the parts on the PC board as shown on this wiring diagram. Note that the board caters for both single and dual-diode packages for D2 (ie, one diode is shorted if a dual diode is used).



The prototype was assembled on an older version of the board and is slightly different in appearance to the final version shown in Fig.6.

If the wiper of VR1 is centred, the charge and discharge times for the timing capacitor will be equal and the output at pin 3 will be a square wave or in other words, its duty cycle will be 50%, ie, 50% high and 50% low. The operation of the 7555 timer is illustrated in the scope shots of Figs.2, 3 & 4. In each case, the top trace (yellow) shows the charging and discharging of the capacitor while the lower trace (green) shows the pulse output from pin 3.

In the scope grab of Fig.2, we show the circuit producing a square wave, with equal charge and discharge times for the capacitor. This is shown by the yellow trace which is a typical triangle waveform.

In Fig.3, we show the circuit producing a pulse waveform with a short (17%) duty cycle which means that most of the time, the output at pin 3 of IC1 is low. Then in Fig.4, we show the circuit with trimpot VR1 set fully clockwise to produce a waveform which has a 100% duty cycle. In this case, the capacitor charging waveform is a classic sawtooth, with a slow charging ramp and a very sudden (almost instantaneous) discharge time. The resultant waveform at pin 3 looks pretty much like a straight line but it actually has extremely short negative excursions corresponding to the negative slopes of the capacitor waveform.

OK, so now we know how the 7555

Resistor Colour Codes

Value	4-Band Code (1%)	5-Band Code (1%)
100Ω	brown black brown brown	brown black black black brown
10Ω	brown black black brown	brown black black gold brown

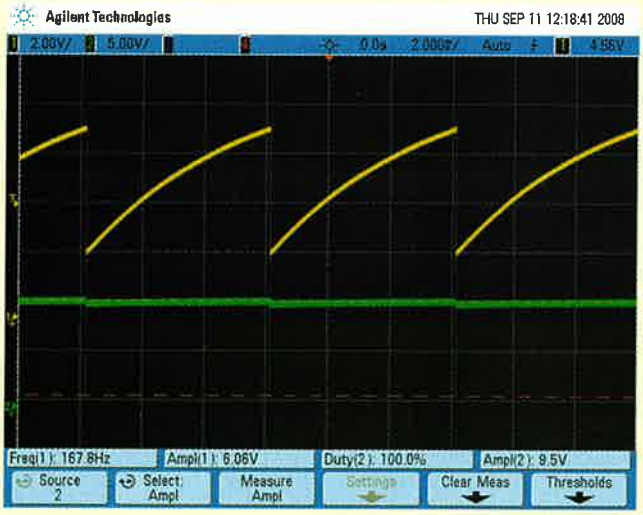


Fig.4: when adjusted for full power to the load (ie, 100% duty cycle), the timing capacitor waveform (yellow trace) is a classic sawtooth with slow charge and very steep discharge slopes.

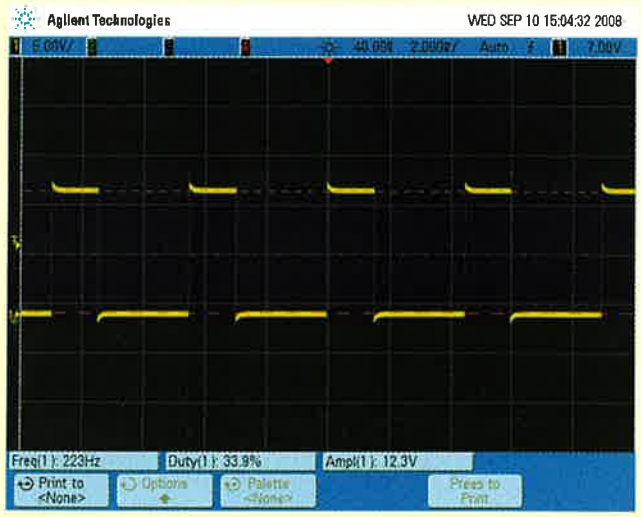


Fig.5: this scope waveform shows the voltage delivered to a resistive load such as an incandescent lamp or heat element. In this case, the pulse duty cycle has been adjusted to about 30%.

operates. Its output at pin 3 is buffered by a complementary buffer stage comprising transistors Q1 & Q2 (emitter followers) and these drive the gate of the Mosfet Q3 via a 10Ω resistor. The Mosfet then drives the load which is connected between the +12V supply and the Mosfet's drain terminal.

Diode D2 clamps the spike voltages which occur each time the Mosfet turns off, when driving an inductive load such as a permanent magnet motor. The adjacent 10µF and 100nF capacitors across the 12V supply are there to reduce the amount of radiated interference produced by the connecting leads to the battery and to the motor.

In fact, you can gauge the amount of interference the circuit produces in an AM radio. Just bring the radio close to the circuit or its leads and tune between stations. You will hear the angry buzz produced by the pulse waveform. Move the radio away by a metre or so and the interference should be non-existent when tuned to an AM station.

Power for the circuit is derived from the incoming 12V supply via diode D1 and the 100Ω resistor. Zener diode ZD1 provides basic supply regulation while the 100nF and 10µF capacitors provide a degree of filtering.

Building it

The PWM control circuit is built on a small PC board measuring 79 x 47mm and coded 05111081. If it comes in a kit it is likely to have corner cut-outs so that it fits into a standard plastic zippy box measuring 82 x 53 x 32mm.

Actually, this kit is almost identical to the "Nitrous Oxide Fuel Mixture Controller" project developed for our *Performance Electronics for Cars* book but the kit for that project has now been discontinued.

The PC board presented here has had a few changes made to it, mainly involving component spacing, diode D2 and the 4-way terminal block. In addition, the tracks to diode D3 have been altered so that this diode now faces the same way as D4.

Note that the unit pictured in this article was assembled on the old version of the PC board (ie, the one used for the Nitrous Oxide Fuel Mixture Controller), so these changes aren't shown in the photos. Just follow the parts layout diagram (Fig.6) to build the unit and all will be well.

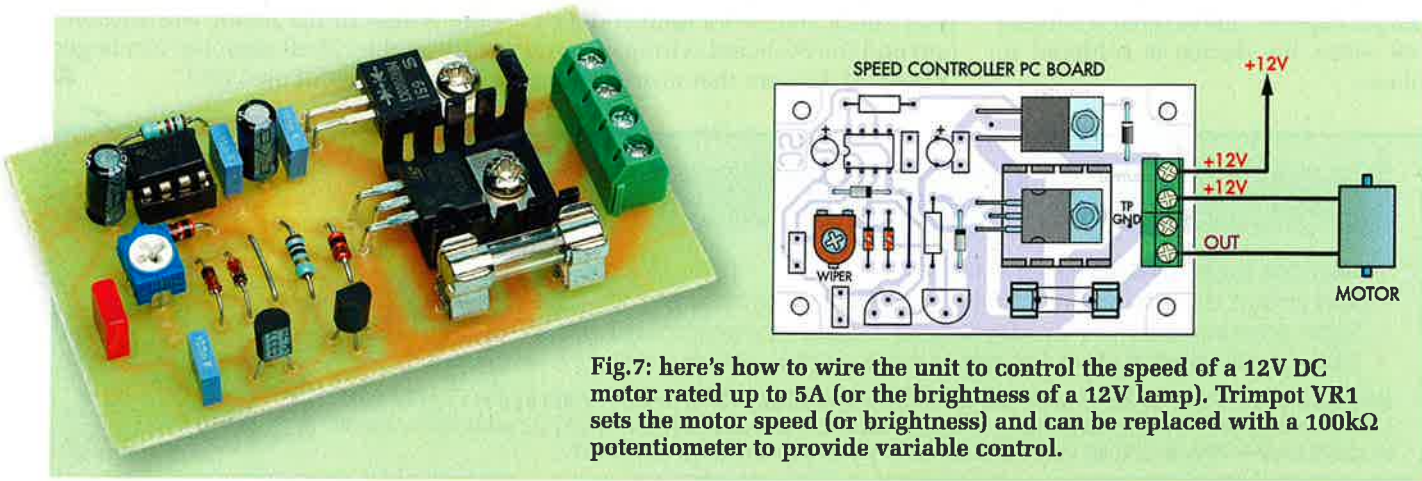
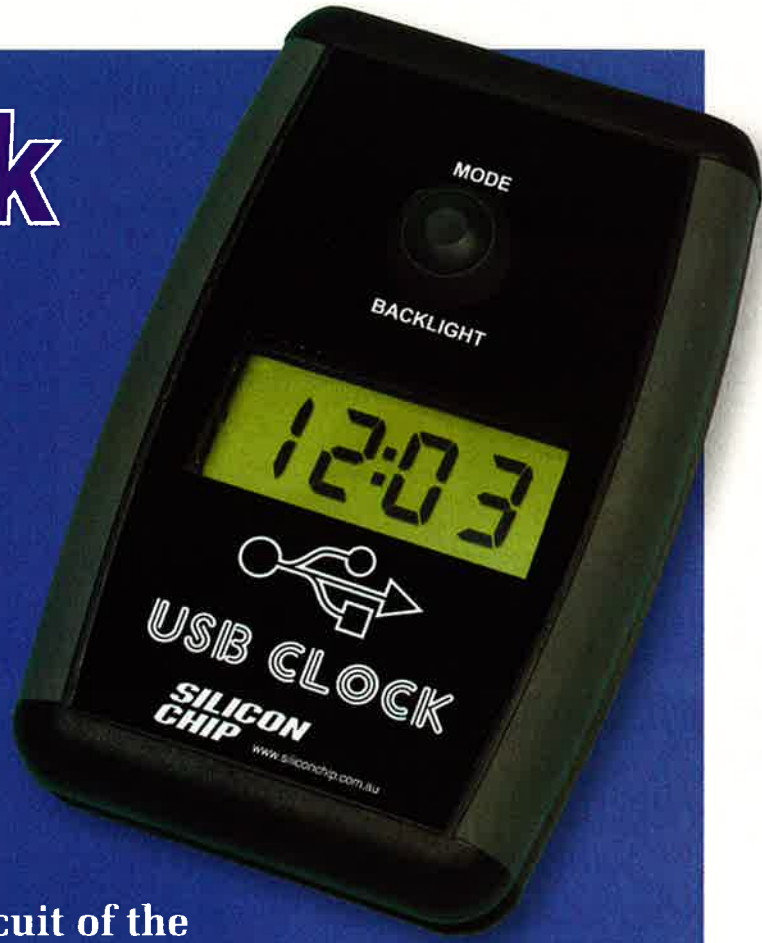


Fig.7: here's how to wire the unit to control the speed of a 12V DC motor rated up to 5A (or the brightness of a 12V lamp). Trimpot VR1 sets the motor speed (or brightness) and can be replaced with a 100kΩ potentiometer to provide variable control.

USB Clock With LCD Readout



Pt.2: By MAURO GRASSI

Last month, we detailed the circuit of the USB Clock and showed you how to build it. This month, we detail the software installation and describe how it is used. We also describe how to synchronise your PC to an internet time server and how to synchronise the USB Clock to the PC each time the PC boots up.

HAVING BUILT the hardware, the next step is to install the necessary driver. The following outlines the steps for Windows XP but other Windows versions, including Windows Vista, should work similarly.

The first step is to download the Microchip installer (**MCHPFSUSB_Setup_v1.3.exe**) from the SILICON CHIP website and run it (it's in the November 2008 downloads section). Note that you must use version 1.3, as older or newer versions may not be compatible. When you run the installer, this will copy the driver to the C:\MCHPFUSB\PC\MCHPUSB Driver\Release folder.

Subsequently, when you first connect the USB Clock to your computer, Windows will recognise the device as a "Microchip Custom USB device". The "Found New Hardware" dialog will then appear (see Fig.7) and you should select the "No, not this time" option and click "Next".

At the following dialog, select "Install from a list or specific location" and click "Next" again to bring up the dialog shown in Fig.8. Select "Search for the best driver in these locations" and enable the "Include this location in the search" box.

Now click the "Browse" button. In the "Locate File" dialog that appears, navigate to where the MCHPUSB files were installed (normally it will be C:\MCHPFUSB\PC\MCHPUSB Driver\Release folder) and select "mchpusb.inf". Click "Next" and Windows will then install the driver.

If the driver is installed correctly, you should be able to see the "Microchip Custom USB Device" entry in Device Manager (provided the USB Clock is connected), as shown in Fig.9 (Control Panel -> System -> Hardware Tab -> Device Manager tab).

Installing/using usbclock.exe

Once the driver has been installed, you can control the USB clock using the **usbclock.exe** program. The first step is to download this program from the SILICON CHIP website (November 2008 downloads section), unzip it and copy it to a suitable folder (eg, create a folder called "usbclock").

Usbclock.exe is a simple program that's run from the Command Prompt dialog (formerly known as a DOS box). It's simply a matter of navigating to the

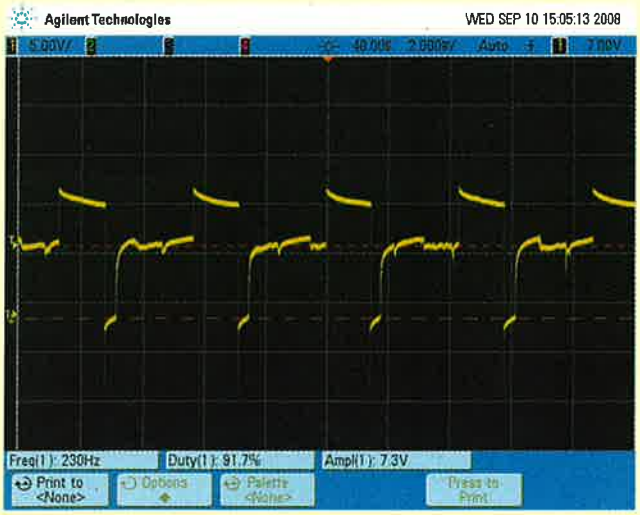


Fig.6: this is the voltage waveform across a motor running at a relatively low speed setting. The hash between "on" pulses is due to the motor back-EMF and the interference produced by the brushes.

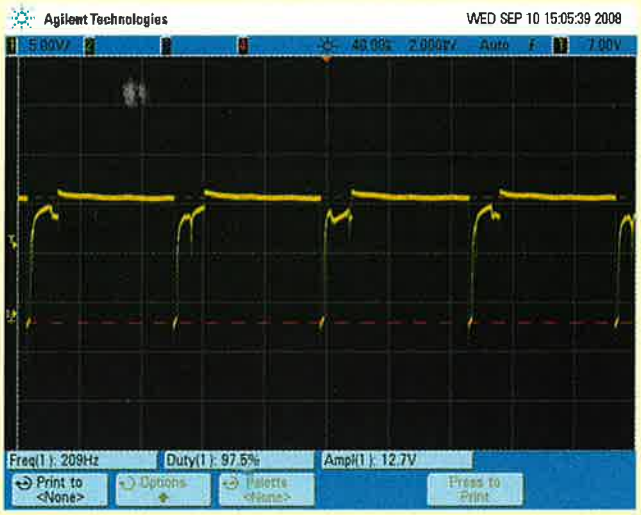


Fig.7: this is the voltage waveform across a motor running at close to full speed (ie, a high duty-cycle pulse output). Once again, the hash from the brushes (shown between pulses) is very evident.

When assembling the PC board, make sure you insert the polarised components the right way around. These parts include the 7555 timer IC, the transistors, diodes, zener diodes and the electrolytic capacitors. Fit all the small components first, followed by the fast recovery diode (D2), the fuse clips, Mosfet and the 4-way terminal block.

When fitting the two fuse clips, make sure you put them in the right way around so that their little retaining lugs end up at each end of the fuse, when it is inserted. **Note also that we have made provision for two different fast recovery diodes for D2, either a 2-lead SOD-59 type such as MUR1560 or BY229 or a twin-diode 3-lead TO-220 type such as the MBR20100CT type.** In the case of the 3-lead type, there are actually two 10A diodes in the package but one of them is shorted out when the device is soldered in place.

When installing diode, crank the leads at right angles so that they go through the board and the hole in the mounting lug lines up with the 3mm hole in the PC board. Before the diode is soldered in place, bolt it to the board with an M3 screw and nut. Do not solder the diode and then tighten the screw and nut otherwise you will stress the diode package and it will fail prematurely.

Similarly, when mounting the Mosfet, crank its leads to suit the board and mount it with a mini U-shaped heatsink. It is secured to the board with an M3 screw and nut and then its leads can be soldered.

Finally, fit the 4-way connector and the board is finished.

Testing

Before connecting the battery, carefully check your work against the circuit and the PC board wiring diagram (Fig.6). Make sure that every component is installed exactly as shown.

Next, connect a low wattage 12V lamp to the +12V and OUT terminals and apply 12V DC from a battery or mains-operated 10A DC power supply. You should be able to vary the brightness from fully on to completely off with the trimpot.

If you are happy with that, you can then install the board in its final position.

By the way, if you want to fit a full size potentiometer (with knob) as a variable control instead of using a trimpot on the board, it is quite simple. Just connect the three wires from the pot instead of the trimpot and make sure that the centre (wiper) wire from the pot goes to the wiper connection on the PC board.

Finally, if you want to reduce the pulse frequency, perhaps to make the whine in the motor less audible, change the 220nF capacitor to a larger value, say 270nF or 330nF. **SC**

Looking for real performance?

- Learn how engine management systems work
- Build projects to control nitrous, fuel injection and turbo boost systems
- Switch devices on and off on the basis of signal frequency, temperature and voltage
- Build test instruments to check fuel injector duty cycle, fuel mixtures and brake & temperature

160 PAGES
23 CHAPTERS

Mail order prices: Aust. $A22.50 (incl. GST & P&P); Overseas $A26.00 via airmail. Order by phoning (02) 9939 3295 & quoting your credit card number; or fax the details to (02) 9939 2648; or mail your order with cheque or credit card details to Silicon Chip Publications, PO Box 139, Collaroy, NSW 2097.

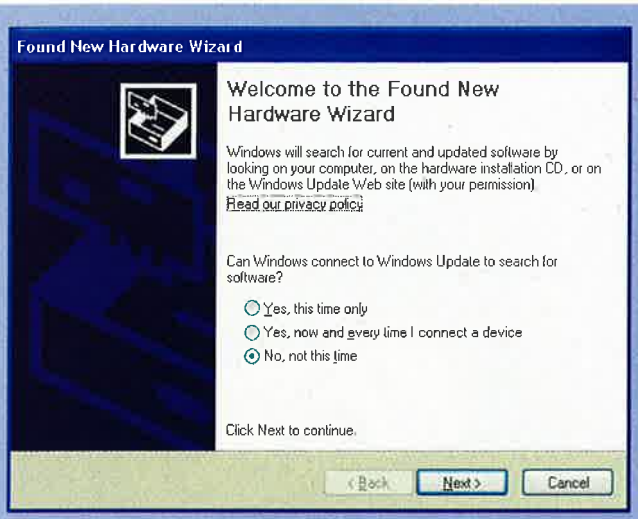

Found New Hardware Wizard
Welcome to the Found New Hardware Wizard
Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission).
Read our privacy policy
Can Windows connect to Windows Update to search for software?
Yes, this time only
Yes, now and every time I connect a device
No, not this time
Click Next to continue.
< Back
Next >
Cancel

Fig.7: this is the dialog that appears the first time the USB clock is connected to the PC. Select the option shown and click the "Next" button.

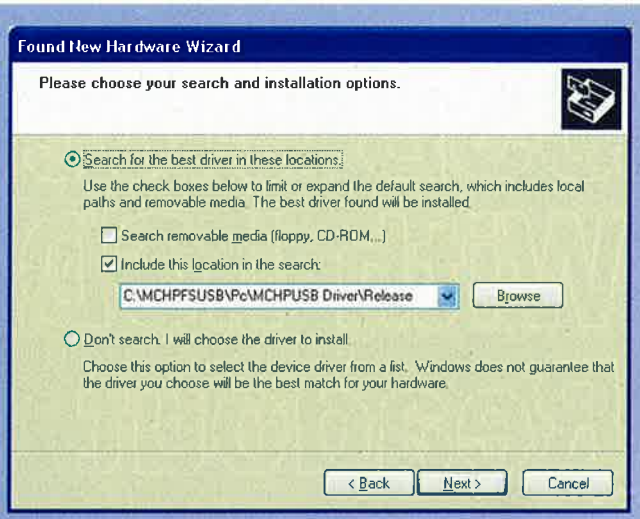

Found New Hardware Wizard
Please choose your search and installation options.
Search for the best driver in these locations.
Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.
Search removable media (floppy, CD-ROM...)
Include this location in the search:
C:\MCHPFSUSB\Pc\MCHPUSB Driver\Release
Browse
Don't search. I will choose the driver to install.
Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.
< Back
Next >
Cancel

Fig.8: selecting "Install from a list or specific location" brings up this dialog. Select the options shown and click the "Next" button. Windows then installs the driver.

Fig.9: this entry will appear in Device Manager if the driver is installed correctly.

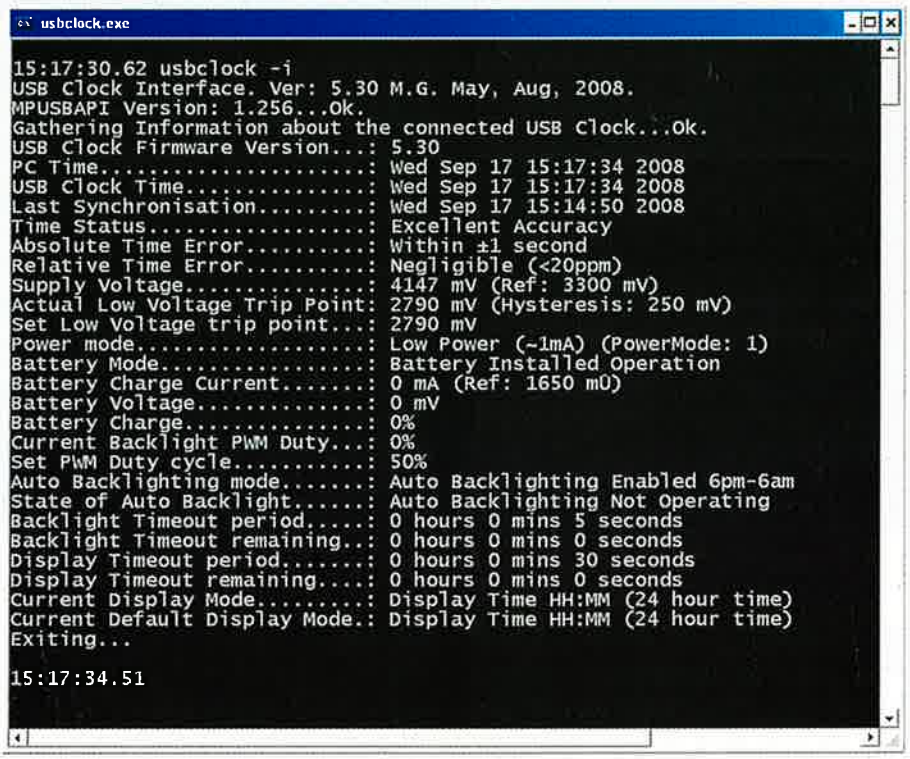

usbclock.exe
15:17:30.62 usbclock -i
USB Clock Interface. Ver: 5.30 M.G. May, Aug, 2008.
MPUSBAPI Version: 1.256...Ok.
Gathering Information about the connected USB Clock...Ok.
USB Clock Firmware Version...: 5.30
PC Time.....: Wed Sep 17 15:17:34 2008
USB Clock Time.....: Wed Sep 17 15:17:34 2008
Last Synchronisation.....: Wed Sep 17 15:14:50 2008
Time Status.....: Excellent Accuracy
Absolute Time Error.....: Within ±1 second
Relative Time Error.....: Negligible (<20ppm)
Supply Voltage.....: 4147 mV (Ref: 3300 mV)
Actual Low Voltage Trip Point: 2790 mV (Hysteresis: 250 mV)
Set Low Voltage trip point...: 2790 mV
Power mode.....: Low Power (~1mA) (PowerMode: 1)
Battery Mode.....: Battery Installed Operation
Battery Charge Current.....: 0 mA (Ref: 1650 mA)
Battery Voltage.....: 0 mV
Battery Charge.....: 0%
Current Backlight PWM Duty...: 0%
Set PWM Duty cycle.....: 50%
Auto Backlighting mode.....: Auto Backlighting Enabled 6pm-6am
State of Auto Backlight.....: Auto Backlighting Not Operating
Backlight Timeout period.....: 0 hours 0 mins 5 seconds
Backlight Timeout remaining..: 0 hours 0 mins 0 seconds
Display Timeout period.....: 0 hours 0 mins 30 seconds
Display Timeout remaining....: 0 hours 0 mins 0 seconds
Current Display Mode.....: Display Time HH:MM (24 hour time)
Current Default Display Mode.: Display Time HH:MM (24 hour time)
Exiting...
15:17:34.51

Fig.10: the USB clock is synchronised with your PC's time by running the *usbclock.exe* program from a command window. This screen grab shows the output after running *usbclock -i* to view all the clock's operating settings.

folder where the program resides, then typing **usbclock** to synchronise the USB Clock with the clock on the PC.

For other functions, simply enter **usbclock x** at the command prompt, substituting the appropriate switch for the "x".

Table 4 shows the various command line switches and their functions. Among other things, you can view the current operating settings (**-i**), change the PWM duty cycle (and thus the brightness) of the backlight (**-p:X**), set the backlight timeout period (**-t:X**), set the auto-backlighting on or off (**-a:X**) and change the display format from the default 24-hour time to 12-hour format (**-y:X**).

Fig.10 shows a typical example of the screen that appears when the **usbclock** program is run.

Driving the USB Clock

There's only one control on the front panel of the USB Clock and that's pushbutton switch S1. You simply press S1 to turn on the backlight. This will be turned on for the duration of the timeout period (set by running the **usbclock –t:X** command) at the set PWM duty (set by running the **usbclock –p:X** command).

Pressing S1 again allows you to scroll through the different display modes of the clock. You can then see the date displayed on the clock as well as other settings. The display modes were shown in Table 2 last month.

Synchronising Your PC To A Network Time Server

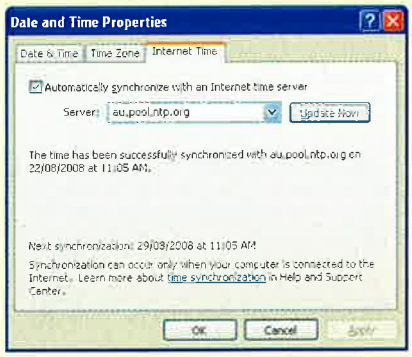

Date and Time Properties
Date & Time
Time Zone
Internet Time
Automatically synchronize with an Internet time server
Server:
au.pool.ntp.org
Update Now
The time has been successfully synchronized with au.pool.ntp.org on 22/08/2008 at 11:05 AM.
Next synchronization: 29/08/2008 at 11:05 AM
Synchronization can occur only when your computer is connected to the Internet. Learn more about time synchronization in Help and Support Center.
OK
Cancel
Apply

Fig.11: this dialog is used in WinXP to enable your PC to synchronise with an internet time server.

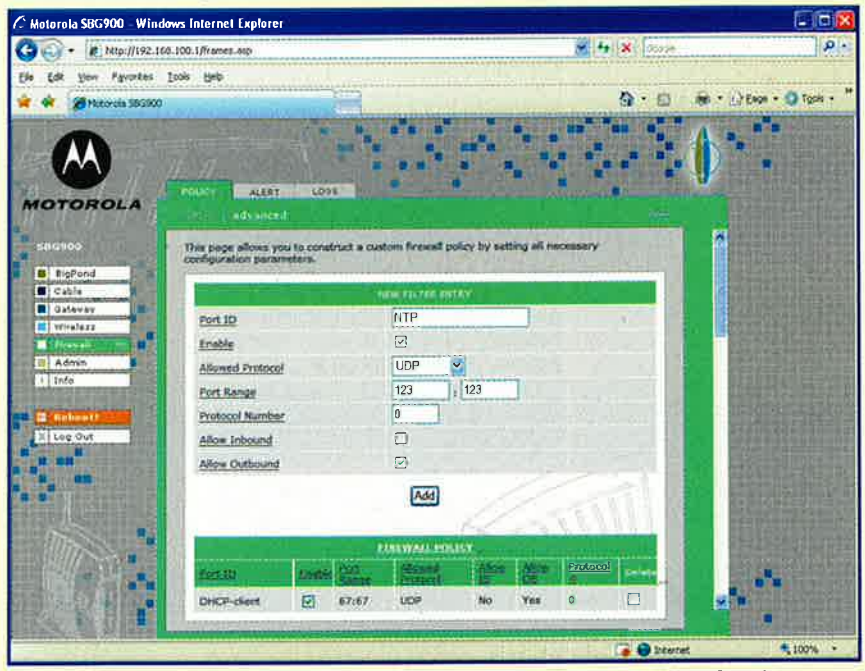


Fig.12: if you have the firwall enabled on an ADSL or cable modem/router, then you will have to enable outgoing UDP connections on port 123. This screen grab shows the set-up for a Motorola SBG900 cable modem.

THE NTP (network time protocol) is used to synchronise "network-enabled" devices (such as your PC) with remote time-servers. Basically, a time-server is a server computer that derives its time from a very accurate reference clock and distributes this time to other computers. The most common time reference for these servers is a GPS clock or GPS master clock.

To ensure that your PC's local clock (and by extension, your USB clock) always shows the correct time, it's necessary to enable NTP time synchronisation in Windows. When this is done, your PC will synchronise with the selected Internet time server once a week, although you can also perform manual updates as well.

NTP synchronisation is enabled in Windows XP as follows:

(1) Double-click the clock in the bottom right corner of the system tray.

(2) Click the "Internet Time" tab on the resulting "Date and Time Properties" dialog to bring up the dialog shown in Fig.11.

(3) Select "Automatically synchronize with an Internet time server".

(4) Enter a valid NTP server domain name into the space provided. The **au.pool.ntp.org** server should work for users in Australia but you can also select one of the default overseas servers from the drop-down list.

Alternatively, there are many other NTP servers available and you can easily do an internet search for them. A good place to start is **www.pool.ntp.org**

(5) Click on the "Update Now" button to test the synchronisation. The Windows NTP service may fail if a firewall is blocking it, although NTP may also fail sporadically even when set-up correctly, due to lost packets or handshaking timing out.

Punching through the firewall

NTP uses UDP port 123, so you must ensure that your firewall is not blocking outgoing traffic on this port. If it is, NTP synchronisation will fail consistently and you will have to change the firewall's settings.

The Windows XP and Vista firewalls allow all outgoing traffic and will work by default. By contrast, other third-party firewalls often block outgoing connections on port 123 and will have to be modified.

Do a search on the Internet to find the appropriate settings for your particular firewall (or check the manual). Note that you only need to enable outgoing UDP traffic on port 123 (not incoming).

Similarly, if you have the firewall enabled on your ADSL (or cable) modem/router, then you may need to modify its settings as well. Fig.12 shows the settings for a Motorola SBG900 cable modem. Again, you only need to allow outbound UDP traffic on port 123.

After the display timeout period expires (from the last switch press) the display mode will revert to the default display mode (set by running the **usbclock –z:X** command). The display timeout can be changed by running the **usbclock –d:X** command.

There's one more feature we need to explain and that's the auto backlighting mode. If enabled (**usbclock -a:1** or **usbclock-a:2** turns it on, while **usbclock -a:0** turns it off), the unit automatically turns the backlight on at the set PWM duty cycle, depending on the time of day (provided that the USB Clock is running on USB power).

If in automatic backlight mode 1, the backlight will turn on between 6pm and 6am. **This means that if you have the USB clock connected to a powered hub, the backlight will come on automatically at night.** By contrast, in mode 2, it will be on all day.

The auto backlighting will not work

Command	Function	Example	Result
usbclock or **usbclock -s**	Synchronises the USB clock with the local clock on your Windows PC.	**usbclock**	The windows time will be synchronised with the USB clock.
usbclock -i	View all relevant operating settings of the USB clock.	**usbclock -i**	You will be able to see all the operating settings of the USB clock on your PC. An example screen shot is shown in Fig.10.
usbclock -p:X, where X is a number from 0 to 100.	Sets the PWM duty for the backlight. The higher the number the brighter the backlighting will be and the greater the power consumption. Note that for values below about 15%, the backlight will not be visible.	**usbclock -p:80**	Sets the backlight PWM duty to 80%.
usbclock -t:X	Sets the timeout period in seconds for the backlight. When switch S1 is pressed the USB Clock will light the backlight. After the time-out period expires, the backlight dims to off.	**usbclock -t:60**	Sets the time-out period to 1 minute.
usbclock -d:X	Sets the display time-out period in seconds. When this expires, the display reverts to the default display mode.	**usbclock -d:120**	Sets the display time-out period to 120 seconds (2 minutes).
usbclock -m:X where X is the number of one of the display modes in Table 2.	Set the USB Clock's display mode for the display time-out period. The clock then reverts to the default display mode.	**usbclock -m:0**	Sets the display mode to display the time in HH:MM (hours, minutes) format.
usbclock -v:X where X is in mV	Sets the USB Clock's reference voltage.	**usbclock -v:3300**	Sets the reference voltage to 3.3V.
usbclock -c:X where X is in mΩ	Sets the USB Clock's sense resistor value.	**usbclock -c:1650**	Sets the sense resistor reference value to 1.65Ω.
usbclock -z:X where X is the number of one of the display modes in Table 2.	Sets the USB Clock's default display mode (and the display mode).	**usbclock -z:1**	Sets the display to show the date.
usbclock -l:X where X is in mV between 2170 and 4500mV.	Sets the USB Clock's low-voltage trip point.	**usbclock -l:2400**	Sets the low voltage trip point to 2.4V. If it is set too high, the backlight will be turned off too soon.
usbclock -a:X where X is either 0 (disable) or 1 (enable 6pm to 6am) or 2 (all day).	Sets the USB Clock's auto backlighting on or off.	**usbclock -a:1**	Sets the backlight to automatically turn on between 6pm and 6am.
usbclock -y:X where X is either 0 for 24-hour time (default) or 1 for 12-hour time.	Sets the USB Clock's time display mode (24hr or 12hr).	**usbclock -y:1**	Sets the USB Clock to 12-hour time.
usbclock.exe -r	Resets the USB Clock.	**usbclock.exe -r**	Resets the USB Clock and all settings are restored to default values.

Table 4: the command line switches for the *usbclock.exe* host program. The USB Clock synchronises its time with your PC's clock when you run this program without any switches and the program can also be set to run automatically when the PC boots.

Making Usbclock.exe Run Automatically

The USB Clock does not synchronise its time automatically with the PC just because it is connected to the PC via a USB cable. To do that, you have to run the **usbclock.exe** program (ie, by typing **usbclock** and pressing the Enter key at the command line).

If you wish, you can automate this procedure by having Windows run **usbclock.exe** each time the computer boots up. This is done by placing a shortcut to the program in the Start-up folder, as follows:

(1) Create a shortcut to the usbclock.exe program by right-clicking it and dragging it to the desktop.

(2) Copy or move this shortcut to the **C:\Documents and Settings\YourUserName\Start Menu\Programs\Startup** folder (YourUserName is your user account name).

Once the above steps have been completed, the **usbclock.exe** program will automatically run each time Windows boots up and thus synchronise the USB Clock to the PC's clock.

Note that you should also set up your PC's local time to synchronise automatically with an internet time server, to make sure that your PC's clock (and thus your USB Clock) is always accurate. The way to do this is set out in a separate panel titled "Synchronising Your PC With A Network Time Server".

when the USB clock is running from battery power. In that case, you will have to turn the backlight on manually by pressing S1.

Tweaking the charging current

The charging current depends on the reference value for the sense resistor. If you wish, this reference value can be changed (to give a more accurate charging current readout) by running the **usbclock -c:X** command.

The default value is 1.65Ω which is the nominal resistance of the two

How The Circuit Conserves Power

One important feature of the PIC-18F4550 is its support for low-power managed modes. Although the use of CMOS ICs is important for minimising power consumption, much of the power conservation is achieved in the firmware

Basically, the microcontroller will respond to interrupts and then go into idle mode, resulting in very low power consumption. In idle mode, peripherals like the screen refresh timer and the timekeeping timer still operate but the CPU is switched off. An interrupt generated by the peripheral will wake the CPU. The interrupt will then be serviced, after which the CPU reverts to idle mode again.

In normal operation without the backlighting, the current consumption is less than 1mA. This means that the clock should be able to keep running from battery power for at least a few weeks before the batteries need recharging.

By contrast, the backlight draws around 200mA at 100% duty-cycle. This reduces to around 100mA at 50% duty-cycle and 80mA at 30% duty-cycle.

In battery mode, the backlight is turned on by briefly pressing S1. It will then stay on for the duration of the timeout period (this can be set by running the usbclock.exe program using the **-t** option, as explained below).

After the period expires, the backlight quickly dims down and turns off. Note that the backlight duty cycle is also set by running the **usbclock.exe** program, this time using the **-p** option.

In addition, as mentioned previously, the microcontroller automatically reduces the duty cycle if it detects that the supply voltage rail is buckling under the load (this will only happen when the backlight is used when running from battery power).

Basically, the microcontroller sets a low-voltage trip point, with an interrupt occurring if the supply voltage drops below this point when S1 is pressed. When that happens, the microcontroller immediately reduces the PWM duty cycle of the backlight.

As a result, if the batteries are sufficiently discharged, the backlight will not turn on when S1 is pressed.

Going one step further, if the microcontroller detects that the supply voltage is below the trip point when the backlight is not being driven (ie, 0% duty-cycle), then the firmware will go into an extended power conservation mode (extra low power). In this mode, the main priority is to keep the real time clock updated, while the display will show "Lo" to indicate a low battery.

The firmware will subsequently exit this mode when the USB clock is connected to a PC and the battery begins charging again.

If the supply voltage drops even lower than this, the firmware assumes that power is soon to be lost or that the battery is too discharged to provide power. In this case, the firmware instructs the microcontroller to go to sleep.

In this state, the CPU and all peripherals are turned off, markedly reducing the power consumption to just microamps.

This prevents the battery from discharging even further.

Of course, at this point, the timekeeping fails. However, it is subsequently synchronised the next time the USB clock is connected to the PC (provided the PC is operating).

parallel 3.3Ω resistors on the PC board. If the resistors don't measure 1.65Ω, you can tweak the reference value to match their actual value.

Normally, however, you don't need to worry about this unless you're very fussy about accurate charging current readings.

Similarly, the supply voltage reading depends on the accuracy of the 3.3V reference voltage. In practice though, this may be slightly off due to manufacturing variations of IC1. It should be close to 3.3V and so the default value of 3.3V should be adequate in most cases.

If necessary, you can change the reference voltage (using the **usbclock -v:X** command) to increase the accuracy of the voltage reading. It should match the voltage at pin 19 of IC1, as measured using a voltmeter. SC

JOIN THE TECHNOLOGY AGE NOW with PICAXE

Developed as a teaching tool, the PICAXE is a low-cost "brain" for almost any project

Easy to use and understand, professionals & hobbyists can be productive within minutes.
Free software development system and low-cost in-circuit programming.
Variety of hardware, project boards and kits to suit your application.
Digital, analog, RS232, 1-Wire™, SPI and I^2C.
PC connectivity.

Applications include:
Datalogging
Robotics
Measurement & instruments
Motor & lighting control
Farming & agriculture
Internet server
Wireless links
Colour sensing
Fun games

Distributed in Australia by

Microzed Computers Pty Limited

Phone 1300 735 420
Fax 1300 735 421

www.microzed.com.au

SERVICEMAN'S LOG

Yes Serviceman: The Moral Dilemma

Jim Hacker in the British TV comedy series "Yes Minister" faced many moral dilemmas in his never-ending battle with the wily Sir Humphrey Appleby. I recently faced a moral dilemma of my own when I wrongly diagnosed a fault in a customer's LCD TV.

Items Covered This Month

- Conia CLCD3278 LCD TV
- Sony SLV-D985PAZ VCR/DVD Combo
- Lost computer password
- Freeplay 3360 (FPR3 360) radio

I was recently phoned by the owner of a local retail shop, asking that I urgently repair an LCD TV which they used (in conjunction with a DVD player) to display one of their products.

When I subsequently arrived at the shop, I found that the set was attached to a wall bracket and they had neither the remote control nor the original stand. That meant that I was behind the eight-ball before I even started.

The TV was a late-model Conia CLCD3278, which is an 82cm LCD set with an internal analog cable tuner. I asked whether it was still under warranty and was assured it wasn't but in any event, they couldn't find the paperwork.

The owner demanded a concrete quotation almost immediately which I said I just couldn't do. Instead, I told him that it would have to go back to the workshop and then I could provide a quote after I had examined it. However, I did say that I thought the problem was due to the power supply and that it could be rather expensive.

After some hesitation, they eventually agreed to let me take the set away. When I got it back to the workshop, I immediately removed the covers and took a look at the dual switchmode power supply. It was completely dead, with no output voltages from either the main or standby supply units.

Subsequent checks showed that the 240V AC supply was available all the way to the bridge rectifier. In addition, none of the parts showed any signs of stress and there were no measurable shorts or open circuits in critical supply paths. By rights, this power supply should have been showing some signs of life.

Next, I tracked down the agents for Conia and was informed that there were no circuits for the set. They also confirmed that this particular set was no longer under warranty and quoted $400 for the MLT666 power supply.

Based on that information, I submitted a quote which, as you can imagine, was not well received. Together with labour, it would mean that the cost of fixing their two-year-old LCD TV would be about two-thirds the cost of a new one.

While their accountant was venting his spleen over this, I continued to spend time trying to find out why the supply wasn't working. There were several ICs, both surface mounted and conventional types, but I couldn't source them, even on Google. A few checks revealed that power was reaching these ICs but because I had no circuit, I couldn't be sure that the voltages were correct.

There was no voltage output at all at any time so, on the basis I had nothing to lose, I removed the power supply for further checks. Once it was out, I carefully discharged the main electros and began making continuity checks

but still couldn't fault anything.

Next, I fitted a socket for the conventional IC in the hope that I might be able to obtain one. After that, I put it to one side while the customer decided what he wanted to do.

After a few days, they decided that they didn't want to proceed and asked what the charge was for the work so far. I replied that it would be just one hour's labour plus one IC socket but if they preferred, I would be quite happy to swap this for the set which I figured might be useful for spares at a later date. They didn't take too kindly to this suggestion, apparently reasoning that I had hatched a plot to defraud them of their broken set.

In the end, it was agreed that I would return the set the next working day, which happened to be a Monday. Come Monday morning, I reassembled the power supply into the set and refitted the back. And just to make sure that nothing else was dangerously amiss, I reconnected the power to the set.

Would you believe it – the set now worked perfectly! I removed the back and checked yet again for any bad connections, intermittent or otherwise, but this time no matter what I did the set was now working properly and refused to fail.

Well, as you can imagine, this left me in an embarrassing situation with only a few hours left before I had to redeliver a supposedly faulty set back to its suspicious owners. I was completely out of ideas as to why it had suddenly come good, so I phoned several colleagues to see whether anyone else had ever encountered anything like this.

AN ELDERLY RETIRED COUPLE BROUGHT IN THEIR SONY COMBO, COMPLAINING IT WAS CHEWING TAPES

Most said no but one told me that he had twice had cases where the power supply (for various different brands of sets) had failed after a power surge but after being completely discharged and left for several days had begun to work again. His theory was that static voltages had caused the internal protection circuits within some of the control ICs to cut in. Once these voltages had gone, the protection circuits allowed the supply to work again.

This explanation seemed logical to me but would it sound reasonable to my client – especially as I intended to charge an extra hour's labour for all the time I had spent on the set. Then there was the problem of warranty. How could I possibly give a warranty in this situation? If the set failed again, it would still cost $400 for another power supply and I wasn't prepared to take the risk that I would have to wear it.

I spoke to the boss and explained as best I could that I was now in a position to repair the TV to component level but could not provide a guarantee. Would they be prepared to take the risk? Well, I was lucky. They decided they would

TRUE AUDIOPHILE SPEAKERS
Danish Engineered Speaker Drivers for Astonishing Sound Reproduction with Clarity & Outstanding Performance
Tymphany & DST bring together Peerless & Scan-Speak the worlds most respected and trusted high-end loud speaker brands for the past 80 years. Visit: www.d-s-t.com.au
Find Specs / details online:
www.d-s-t.com.au
Available from:
Wagner Electronics
138 Liverpool Road,
Ashfield, NSW, 2131
Phone: 02-9798-9233
Fax: 02-9798-0017
Email: sales@wagner.net.au
Web: www.wagner.net.au
Peerless vline
vifa innovation lives on
SCANSPEAK

and they got the set back for a fraction of the original quote.

I checked with them some weeks later and the set was still working, so it looks like my colleague's theory was correct.

Sony VCR/DVD likes tape

An elderly retired couple brought in their 2002 Sony SLV-D985PAZ VCR/DVD Combo, complaining that it was chewing tapes. Now admittedly Sony is a top brand but most of these combos are just not economical to repair, as new ones are so cheap and technology just keeps on getting better.

However, some people just get used to using one piece of hardware and just hate the thought of learning new stuff all over again and so this couple decided to get their Sony fixed, even though it really wasn't worth it.

The tape was getting chewed up along its edge and the usual cause is the pinch roller. A new lever assembly (part No. 3-067-784-01) and a good clean soon fixed the problem. I returned and installed the unit and thought that that would be the end of it.

However, you can imagine my embarrassment when four months later they brought the unit back again, complaining that it was still chewing tapes. When I examined it, I noticed that Fast Forward and Rewind were slow and that the tape was being chewed up when ejected because the tape wasn't being pulled back into the cassette housing in time before it was ejected.

I pulled the deck out and made sure that the belt to the capstan motor wasn't slipping for any reason. Often the pulley on the capstan motor cracks and slips but everything was OK until I removed the reel idler clutch assembly and disassembled it, whereupon I found hairline cracks in the gear centre assembly. The only problem was that my genuine service manual marked these parts as "not supplied" in the exploded parts diagram, with no part numbers given.

Despite this, I thought it was worth a chance to try and order the parts I needed by description. Speedy Spares from Melbourne was able to decipher this (probably with the use of an additional service manual I didn't have) and came up with the exact part (AC6620581A). I fitted it and reassembled the whole machine which now worked perfectly.

My main problem now is explaining that this fault was different and had nothing to do with the previous symptoms and accordingly there will be additional charges.

Computer hassles

A client recently brought in a computer that he'd bought secondhand. It ran Windows XP Home and apparently was in good working order. His problem was that he didn't have the administrator's password so he couldn't log on as the administrator.

Fortunately, there is a very clever freeware Linux program that can solve this problem. This program can be downloaded from **http://home.eunet.no/~pnordahl/ntpasswd/** and is used to make a bootable CD or floppy disc. The machine is then booted from this disc and the password recovery program goes straight to the security configuration files and lets you edit them. Apparently, it works not only with Windows XP but also with NT, Windows 2000 and Vista.

The trouble with this installation was that even after I'd done this, it still wouldn't let me in because of an unspecified account restriction. I did manage to get in as a guest but without administration rights, which is very restrictive. The problem was that the list of user names shown by running the password reset disk did not match the user account names in the Control Panel.

In the end, I reasoned that this account restriction was probably because of an additional domain name that would not let me access the individual user accounts fully. I messed around trying everything until I finally ended up deleting all the administrators! After some initial panic that I had lost access to the client's important files, I went "Googling" until I asked the right question.

Fortunately, in XP Home, if you boot up in Safe Mode you can create a default administrator and a new password. This back door saved my bacon and restored control to the computer in normal mode. A more dangerous

and risky way is to use Regedt32.exe but I really wouldn't recommend that unless you are an expert.

Finally, don't mess with the password reset program unless you know what you are doing or have nothing to lose. You could end up in a mess if you do.

Getting the green light

This next story came from a colleague and is about a guy in South Africa who bought himself a new TV set. He subsequently returned to the store the very next day, complaining that the set did not work properly. However, when the salesman plugged it in, it worked perfectly in the showroom.

Thinking that it might be an intermittent fault, the salesman didn't argue and exchanged it for another set. But that wasn't the end of it because the customer was back the next day with exactly the same complaint.

Again the salesman plugged it in, again it worked perfectly, and again he replaced it without argument. But you've guessed it – the customer returned the very next day complaining that this third set was also faulty.

At this stage, the long-suffering salesman suggested that they take the set to the customer's home to see if they could get to the bottom of the problem. Sure enough, when he plugged it in, the set initially came on but then switched off, came on, went off again and so on in a continuous on/off cycle.

When quizzed as to source of his electricity supply, the customer pointed out of his window to the traffic lights on the adjacent corner! He was leeching the power off the grid supplying the lights and the TV was turning on and off in perfect sync with the green light!

The $64,000 mistake

We've all heard about the $64,000 question. Well, this story is about a $64,000 mistake. It comes from Brett and what follows is in his own words . . .

After many years in the IT and electronics industry, I made an error that would make any manager wince and gave a financial controller apoplexy.

I was the Logistics Manager in New Zealand for a large American computer company based in Texas. One of my jobs was to ensure that all our branches had an adequate supply of spare parts for all the equipment installed in their respective regions. Budgets had to be met while maintaining branch stocks with everything they would reasonably require – sometimes a juggling act of almost impossible proportions. And with new equipment being released regularly, I got lots of practise at treading that line.

One day, a salesman sealed a contract with a large new customer. However, it was conditional on supplying a certain type of tape drive that was compatible with their existing system. It was known internally that such a unit was going to be released but much later in the year. In fact, it would be too late for the sale to go ahead but the customer was considered prestigious and so the American head-office agreed to supply a unit ahead of schedule to secure the contract.

And so, on that basis, the contract was signed and the equipment ordered.

The equipment, including the tape drive, arrived on time, having undergone all its normal pre-installation checks. However, our company had yet to secure detailed or second level documentation (in those days, "second level" meant component level repair). Instead, all we had at that stage was some preliminary material and a basic manual from the OEM supplier.

When the tape drive was unpacked, it worked for about an hour, then suddenly failed. The lights came on but the tapes refused to load. There was no smoke, no unusual sounds or anything other indications of trouble – just a failed unit that none of us had seen three hours earlier.

This was a large beast in a 19-inch rack and our buy price was just under $US30,000. To convert US dollars to landed cost, we used a quick rule of thumb that worked very well, taking into account sales tax, duty, freight, insurance, etc. We added 75% to our buy price and then converted that to New Zealand dollars. The company purchased forward exchange so we always knew that at least the exchange rate was correct.

With the exchange rate then in force, our landed cost for a whole unit was a fraction over $64,000. I had the authority to buy whatever spare parts I deemed necessary and this was reflected in my budget. I don't recall the actual amount but it was under $10,000 per month.

Getting back to the tape drive, it was opened and a visual inspection revealed a broken belt. The drive motor turned and neither of the two sprockets it went around seemed jammed or tight. In light of this I ordered two belts to be delivered by international courier. However, head office had no spares and referred me to the manufacturer. They couldn't even supply the part number of the belt.

This was the age of the telex machine and as was common practice, we all sent own telexes. Anyway, I set a telex requesting two spare belts, describing where this item went and what it did in some detail, to ensure the correct units were sent. And towards the end of the telex was a sentence along the lines of "please send the described belts by international courier for model XYZ tape drive".

The following day, I received confirmation of my order but they declined the courier request and said my order would be filled by immediate airfreight – at a premium, of course. OK, that was fine by me since we needed them in a hurry.

About 10 days later, the Finan-

The Audio Component Specialists
• Speaker drivers - tweeters to 18" subwoofers - plus kits
• Capacitors, terminals, wire, coils and parts
• Specialist electronic audio components
• Home hifi and car audio
• Public address and DJ equipment
• Industrial and commercial audio parts
• Much more online or phone (02) 4627-8766
soundlabs GROUP
www.soundlabsgroup.com.au

I WOULD BE DOING MY BIT FOR THE PLANET BY FIXING THEM...

cial Controller called me and asked whether I had placed an order from this OEM supplier, to which I replied that I had. He sounded like he was having either a panic attack or a heart attack, or possibly both. He also demanded to know on whose authority I had placed the order.

I replied that, for such a small amount, it was well and truly within my own authority, to which he asked just how much b***dy authority I thought that was. An ordinary day was rapidly starting to deteriorate. He then asked if I knew how much the order came to and I said no but an educated estimate of $10 per belt would bring the total, including airfreight to under $NZ60.

My deteriorating day then suddenly got a whole lot worse. Apparently our freight agents had just advised our orders administrator that there was a complete tape drive at the airport. It had been cleared through customs and was ready to ship. Where did we want it?

Huh?

That wasn't the end of it, of course, because our Financial Controller was holding an invoice for just over $NZ64,000. No wonder he was having a panic attack!

I told the Financial Controller about the failed belt in the unit we had and explained that I had ordered two. The customer was a high priority, so I had asked for priority shipment. Clearly the OEM had made a mistake. When asked to prove this, I simply got my telex copy and read it to him. And that is when it sunk home.

I had ordered two belts for that model of tape drive. However, in my telex I had dropped a single letter from one of the words. Instead of the telex reading "would you please send the belts for a tape drive", it actually read "would you please send the belts OR a tape drive" – a totally different request.

Unfortunately, I had missed this simple error when I proof-read the telex before it was sent. So a single dropped "f" ended up costing an unexpected $64,000. I was eventually forgiven but jokes at my expense involving the letter "f" abounded for many months to come.

The previous week I had been one of those who had laughed and made snide comments when an engineer from a rival vendor dropped a spanner into a large IBM printer while doing an adjustment. Unfortunately, the printer was turned on at the time and the spanner bridged a smoothing capacitor on a 60A power supply rail, melting the wiring harness.

The result was clouds of smoke and a tripped building fire alarm. Worse still, the halon gas flood system activated, leaving a prominent Auckland company without any computing facilities for four days.

Maybe if I had been more sympathetic, God would have inserted that missing "f" for me!

Saving the planet

Despite the modern-day emphasis on greenhouse energy-saving "eco" devices, I was still surprised when I was asked to repair an old clockwork dyno-powered radio.

These radios were first designed by a British accountant called Trevor Baylis in 1989. He went on to form Baygen Power Industries (now Freeplay Energy) to produce these radios for people living in outback South Africa where there is no electricity.

These wind-up radios use a clockwork constant velocity spring to turn a DC generator dynamo (initially an alternator). This charges a nicad battery which in turn powers the radio. Later models were improved by the addition of solar cells. They were initially expensive but the price has since come down considerably.

Anyway, I was brought in not one but two Freeplay 3360 (FPR3 360) wind-up radios, both of which were dead. And although repairing them was hardly an economic proposition, my curiosity got the better of me. In addition, I would be doing my bit for the planet by fixing them – after all, one good turn deserves another.

The first one I tackled had a slipping belt which meant that the dynamo wasn't turning fast enough to charge the battery. I replaced it only to find that there was now a loud squeal coming from the gearbox. Lubricating this with grease fixed that problem and so the first unit was back in operation.

In the second unit, the dynamo had seized but I quickly got it working again by lubricating the bearings. I then found that the wind-up mechanism would not unwind and this was also fixed by applying a lubricant. For good measure, I changed the belt as well and the dynamo was now working but even after charging the batteries for six minutes the unit still refused to work.

The problem wasn't hard to find, with the two rechargeable batteries (650mAh NiMH types) only able to muster 1.2V between them. Obviously one cell was cactus and replacing it fixed the second radio. SC

BIRTHDAY BONANZA

NEW FOR 08 WIND GENERATORS

The new super-compact 300W units are a technological step up from our other two models. They feature moulded, compact, efficient blade design, are lightweight, have neodymium magnets, and the charge controller is built into the generator head. They also feature slip rings to avoid cable breakage. These 300W units will start spinning at just 2.5m/s wind speed, and will produce their rated power at 12m/s (max power 500W at 15m/s). Available in 12V and 24V outputs, all parts fit into one box weighing just 17kg - making it convenient to transport.

*No mounting hardware, poles or guide wires included.

MORE INFO AVAILABLE ONLINE

- Rated Power: 300W
- Max Power: 500W
- No of Blades: 3
- Blade Material: ABS
- Included: generator, blades, tail, hub, nose cone

300W 12VDC $599 Cat: MG-4530

300W 24VDC $599 Cat: MG-4532

Set of 3 Spare Blades for to suit (Cat. MG-4534) $69.95

NEW FOR 08 AA & AAA BATTERY FAST CHARGER

Super Fast 15 Minute Charger for AA & AAA Ni-MH Batteries. The charger uses Delta V voltage detection to charge the batteries to optimal levels and ensure long battery life. Charges AA & AAA in 15 minutes. Car charging cable and mains plugpack included.

- Dimensions: 130(L) x 78(W) x 36(H)mm

$69.95 Cat: MB-3531

ALARM CLOCK WITH 1.5" DIGITAL PHOTO VIEWER

NEW FOR 08

Take your memories with you when you travel. Pocket sized, this is the ideal travelling companion. Use the included Photo Viewer software to download and edit your photos then view them in slideshow or single frame mode.

- Compatible with Windows 98, 2000. ME, XP, Vista, Mac OSX 10.4
- Supports JPEG, BMP, TIF, GIF or PNG images
- 12/24 hour clock with calendar
- Alarm with snooze function
- Backlit LCD
- Batteries included
- Measures: 93(H) x 58(W) x 14(D)mm

$39.95 Cat: QM-3778

PAY TV SET-TOP-BOX REMOTE CONTROL

Designed specifically to operate your Pay TV Digital Set Top Box and give you direct access to the special features available on the name brand remote. Approx 180mm long.

NEW FOR 08

- Operates the FOXTEL® and Austar Digital Set Top Box
- 2 x AA batteries included

Stock product may vary from picture

$19.95 Cat: AR-1735

NEW STORE IN NZ - HASTINGS

819 Heretaunga St West
Hastings NZ 4122
Phone: (06) 876 0239

RF PRESENTER WITH LASER POINTER

Combining a laser pointer and an RF remote control, this handy device gives you control over your PowerPoint presentations, training sessions or slide shows. The receiver connects to your PC's USB port and gives you page up/down, play and blank screen functions. Ideal for corporate trainers, conferences or just for the family holiday slide show.

NEW FOR 08

- Battery included
- Up to 10 metre range
- Dimensions: 88(L) x 34(W) x 9(H)mm

$39.95 Cat: ST-3111

NEW FOR 08 SATA HDD DOCKING STATION

Allows you to dock any 2.5" or 3.5" SATA hard-drive for easy transfer of files. A great tool for those who regularly clone drives or need to swap or check old SATA drives.

$59.95 Cat: XC-4690

Includes:
1 x 1m eSATA Cable
1 x eSATA Bracket Cable
1 x 290cm 5-pin male mini USB to regular male USB
Up to 480Mbps transfer rate with USB 2.0
Up to 3Gb/s transfer rate with eSATA

1/10 SCALE RC ELECTRIC BUGGY OR MONSTER TRUCK

NEW FOR 08

Don't be fooled by the price tag, these are serious 1/10th scale electric off-road remote control racing cars! Each is constructed around a lightweight hardened plastic chassis, and features front and rear fully adjustable independent suspension with oil-dampened shock absorbers, full-time shaft-driven 4WD with front and rear geared differentials, lightweight aluminium top plate for extra chassis strength, hi-speed steering servo, electronic speed controller (ESC) and hi-torque RC540 brushed motor.

Recommended for ages 12 yrs +

Due late November

Two models available

$199 Cat: GT-3670

$219 Cat: GT-3672

Buggy GT-3670 Monster Truck GT-3672

NEW ROCKINGHAM STORE

1/61 Dixon Road
Rockingham WA 6168
Phone: (08) 9592 8000

40W AMORPHOUS SOLAR PANEL

WITH JUNCTION BOX

The junction box is IP65 rated and the connectors are IP67 rated. Both are TÜV rated. 20 year limited warranty.

NEW FOR 08

- Maximum power: 40W peak
- Rated Voltage: 12V
- Open circuit voltage: 29V
- Short circuit current: 2.3A
- Voltage @ max power: 18V
- Current @ max power: 2.0A
- Dimensions: 1253 x 643 x 37mm
- Weight: 14.7kg

$319 Cat: ZM-9034

While Stocks Last - No Rainchecks

Jaycar Electronics
Better, More Technical

All-In-One Card Reader

NEW FOR 08

The card reader that reads everything. Supports: SD, Mini SD, SD Ultra II, SD Extreme III, MMC, MMC II, MMC 4.0, RS-MMC, HS RS-MMC, MMC Micro, M2, MS, MS Pro, MS Pro Duo, MS Extreme Pro, MS Extreme III Pro, MS Ultra II Pro, HS MS-MG Pro HS MS-MG Pro Duo, MS ROM, MS Select, XD, XD(M), XD(H), CF I & II, CF Ultra II, CF Extreme III, CF Extreme, HS CF & Micro-drive.

- USB 2.0
- Size: 60(L) x 40(W) x 13(H)mm

$24.95 Cat: XC-4849

USB DVD Maker

NEW FOR 08

Turn your ageing collection of VHS and Betamax video tapes into new video productions or record live video straight to your DVD or CD burner. This new & improved version works with a Mac, allows you to publish your videos on You Tube & many more features.

- Supports USB 1.1 & 2.0 Plug-and-Play
- Resolution up to 720 x 576 @25 fps (PAL) or 720 x 480 @30fps (NTSC)
- Composite Video input via RCA connector or S-Video mini-DIN
- Stereo audio input via RCA connectors
- Audio output via 3.5mm stereo plug
- Dimensions: 35(W) x 95(D) x 15(H)mm

$99 Cat: XC-4867

Composite Video to VGA Converter

NEW FOR 08

This compact converter box accepts a range of video input signals and converts them to VGA specification for use on CRT, LCD, etc. Also accepts YPbPr input for DVD players, Xbox®, Wii®, or other video sources up to 1080i. Simple on-screen set up. No software required. Includes remote control. 145mm wide.

MORE INFO AVAILABLE ONLINE

$99.95 Cat: XC-4873

FOUR CHANNEL DVR WITH FOUR COLOUR CAMERAS

NEW FOR 08

This is an excellent DVR that is ideally suited to smaller surveillance installations around the home or office. It uses MJPEG video compression and can store over 150 hours of video on its 250GB hard drive. Recording setup is simple and various trigger modes can be set across the day including timer recording, motion detection & manual operation.

Supplied with 4 x weatherproof colour night vision cameras, connecting leads and wireless remote.

- 1 x composite video output
- Frame rate 25fps (Quad mode)
- Note: Monitor not included.

Was $599

$549 Cat: QV-3063

SAVE $50

SCREEN SHOTS

Rapport CCTV Field Tester

Designed with portability and the professional CCTV engineer in mind, this is an advanced piece of test equipment with a variety of functions. As well as performing multimeter functions, it will test the quality of a video image signal and display it on the 3.5" LCD.

- Rechargeable Li-Po battery
- CCTV video monitor
- Video signal generator
- Digital multimeter
- Input voltage: 12VDC
- Charging time: 6 hours
- Multimeter: 88(W)125(H) x 40(D)mm

$999 Cat: QM-3823

NEW FOR 08

Combination Lock Key Safe

NEW FOR 08

Keep control of your keys. Key Safe allows you to give or remove access to anyone you choose by simply changing the combination. Ideal for storing spare keys, keys for the kiddies, tradesman, the boat, garage, access cards etc. Set any combination you like.

$49.95 Cat: LA-5357

- Weatherproof rubber cover
- Cast from 2mm thick aluminium
- Dimensions: 115(H) x 62(H) x 50(D)mm

USB RJ45 Extension Adaptor

Connect any USB device to your computer from up to 50 metres away via a standard Cat 5 network cable. Now you can have your printer, webcam, keyboard, mouse or any other USB device exactly where you want it without having to move your computer around.

NEW FOR 08

- PC and Mac compatible
- Uses standard Cat 5 cables
- Supports USB 1.1
- Supplied with transmitter and receiver

$59.95 Cat: XC-4884

5 Port 100/1000 N-Way Gigabit Switch

NEW FOR 08

A high performance switch that offers a cost-effective means of increasing network performance and reducing congestion. This is achieved by managing the transmission of data packets on the network and enables simultaneous connections to be made between several machines without interfering with data being exchanged on the other connections. 9 VAC power pack included.

- Standards compliance: IEEE 802.3, IEEE 802.3u, & IEEE 802.3ab
- Size: 130(W) x 103(D) x 27(H)mm

$79.95 Cat: YN-8089

COMPUTER LEADS

NEW FOR 08

A range of SATA and eSATA data/power cables for use with personal computers and external serial ATA devices.

eSATA to SATA

Allows you to connect eSATA devices to regular SATA ports.
Colour: Red
Length 0.9 metre

$9.95 Cat: PL-0757

Male Molex to 2 x SATA Power Converter

Power up to 2 SATA devices from a 4-pin male Molex connector.
Length: 200mm

$9.95 Cat: PL-0759

7 Pin Female to 7 Pin Female SATA Data Cable

Colour: Red
Length: 1 metre

$9.95 Cat: PL-0980

Female to Right Angle Female SATA Data Cable

Colour: Red
Length: 1 metre

$9.95 Cat: PL-0981

eSATA Female to Female Cable

Supports data transfer rates up to 3Gbps
Colour: Maroon
Length: 2 metres

$12.95 Cat: PL-0982

MPEG-4 Player AV/SVID/VGA out with Remote & PSU

Boasting composite, S-Video, component and RGB video output with stereo and digital (SPDIF) audio output, it is compatible with almost any home theatre system. With up to 500GB of hard drive storage (IDE HDD not supplied), you can keep a large library of movies and music on the device to entertain for days. PC connection is made easy with the USB 2.0 interface and supplied USB cable. The unit features a cool blue LCD and backlit control panel and is supplied with a slim line remote control that allows for full playback functions, zoom and slideshow control. The included stand allows for vertical mounting.

- Power supply, 1 metre USB lead, 1.5 metre AV lead and stand all included

NEW FOR 08

$169 Cat: XC-4866

USB Optical Mouse with Number Keypad

NEW FOR 08

Notebook computers are great when you are moving about or space is at a premium. However, the lack of a proper numeric keypad and mouse can be a real nuisance. This problem is easily fixed with this new combination USB keypad and mouse. It simply plugs into the computer's USB port and gives you a full function numeric keypad and mouse.

- Lead length 700mm.
- Measures: 67(W) x 110(L) x 20(H)mm

$29.95 Cat: XM-5138

USB 2.0 Graphics Adaptor

An excellent USB to VGA adaptor that allows you to connect a second display device & is perfect for viewing large spreadsheets or running two different applications in full screen mode, without overlapping windows.

- Requires Windows 2000, XP, or Vista
- Supports resolution up to 1280 x 1024
- Software included
- USB powered
- 80mm long

$89.95 Cat: XC-4874

STAINLESS STEEL AUTO OPENING RUBBISH BINS

Never have to touch the germy garbage bin again. When you're within range, the sensor automatically opens the lid for you. Perfect to protect against germs when touching the lid and for those with a genuine need, like the disabled.

NEW FOR 08

6.5L Stainless Steel Auto Rubbish Bin
350(H) x 200(Dia)mm
$39.95 Cat: GG-2312

30L Intelligent Rubbish Bin with DC Input
560(H) x 300(Dia.)mm
$79.95 Cat: GG-2314

42L Rubbish Bin with Intelligent Sensor
755(H) x 305(Dia.)mm
$99.95 Cat: GG-2317

MORE INFO ON PAGE 2

COMMAND-A-MAN / WOMAN REMOTE CONTROLS

Command-a-Man

Is your man a fat slob who sits on his bum all day watching the footy and sinking tinnies? Wait no more ladies! Use your remote to take control of the slob. All the functions you need are right at your fingertips - Talk About Shopping, Shoes, Need Flowers/Chocolate/Massage etc. It also has a function for putting the toilet seat down, but we're fairly sure it doesn't work - technology can only do so much.

- 3 stop functions: Snoring, Farting, Belching
- No batteries required - powered by mind control

NEW FOR 08

$9.95 Cat: GT-3170

Command-a-Woman

Finally someone has decided to put technology to a worthwhile use. Just point the remote at the subject i.e the missus, and select one of nine functions: Cook, Cle Remove Clothes, Say Yes, Leave etc. It also has a Dial- Breast Enhancer/reducer and a Hurry Up function for w you want her to get a move on so you can get to the footy.

- Three stop functions - nagging, whingeing, moaning
- No batteries required - powered by chauvinism
- Requires an IQ of at least 10 to operate

NEW FOR 08

$9.95 Cat: GT-3172

3kg Kitchen Scales

These scales are easy to use and will come in handy around the kitchen. Measuring up to 3kg, they have a resolution of 0.5g and a tare function so that you can disregard the weight of the mixing bowl and only weigh the ingredients. Will weigh in both metric and imperial.

$39.95 Cat: QM-7257

NEW FOR 08

- Requires 2 x AA batteries
- Measures: up to 3kg
- Resolution: 0.5g
- Auto power off
- Dimensions: 145(W) x 210(L)mm

Coughing Lung Ash Tray

This is sure to help you give up. Each time you put down your cigarette the ashtray coughs and splutters to remind you how bad smoking is for your health.

- Uses 2 x AA batteries not included.

$9.95 Cat: GH-1330

Pill Box Reminder with Alarm & Pulse Meter

If you're on regular medication, you've probably tried different ways to remember to take them. This handy reminder has five compartments for different medications, each with its own alarm and can be triggered up to five times a day.

NEW FOR 08

$19.95 Cat: GG-2002

- Built-in pulse meter
- Vibration & beep alarm
- Snooze • Easy-to-read backlit LCD
- Button can be locked to prevent accidental trigger
- Measures: 80(Dia) x 32(D)mm

Military Helicopter Alarm Clock

Set the alarm and when the it goes off, the chopper makes lots of jet engine noises. It also launches the propeller into the air and it flies around the room. Battery or mains powered.

NEW FOR 08

- Requires 4 x AA batteries
- Suitable plugpack: MP-3144
- Measures: 335(L) x 70(W) x 80(H)mm

Due late November

$19.95 Cat: AR-1766

WIRELESS TEMPERATURE / SOIL MOISTURE MONITOR

Monitor the moisture content in the soil at up to three locations. One remote sensor is included and you can add up to two extra sensors. A must for the mad-keen gardener or for small-scale agriculture projects.

$29.95 Cat: QM-7206

NEW FOR 08

- Requires 4 x AAA batteries
- 433MHz, range of 50m
- High/low temperature alert
- Min/max temperature reading
- Celsius or Fahrenheit
- Receiver 68(W) x 76(H) x 25(D)mm
- Sensor 66(W) x 195(H) x 25(D)mm

Additional sensors available separately - QM-7207 $14.95

Nightingale Alarm Clock

Wake up to the delightful sound of a bird chirping. He rocks back and forward as he whistles, gently stirring you from your slumber. Extremely easy to use with simple to operate alarm on/off, alarm, time, minute and hour buttons and a blue LED display.

$39.95 Cat: AR-1765

- Mains operated
- Requires 1 x 9V battery for back up in the event of a power failure
- Dimensions: 160(L) x 50(W) x 140(H)mm

Remote Control LED Clock with Temperature Display

Be mesmerised by this amazing clock! The hours and minutes are displayed on the easy to read 70mm high 7-segment digital display, and the seconds by an analogue incremental display - a second mark lights up as each second passes. It can be wall or table mounted.

- Remote controlled
- Requires 4 x AAA batteries
- Mains adaptor included
- Stand included
- Measures: 280(Dia) x 30(D)mm

$129 Cat: AR-1796

47

We Goofed!

Under the course of any year we look at about 2 to potential new products. Only about 900 to 1000 ma to the catalogue.

When we saw the AA-0474 valve amp we were very excited. We knew that many people wanted a stereo watt valve amp but were put off by the normal high p The price of the AA-0474 was absolutely fantastic – fantastic as it turned out. And we goofed because w did not look hard enough at the product.

This product is NOT a full valve amplifier. It has a val preamp section and a solid state power amp section Worse, it is made to look like it has a valve power ar section.

Even though the Chinese manufacturer told us that i a full valve amp we should have looked closer. (The technically called a Hybrid).

If you have purchased one of these units from us or stockist and you want your money back, simply retu unit to any store for a full refund, outer carton or not you have purchased from a Jaycar stockist, send it to US for a refund. (Make sure you give us your retu address details).

If you have bought one and are happy with the unit, please feel free to keep it. (It actually works well!) W give you a $30 gift voucher as goodwill gesture if y in and show us your original receipt.

We sincerely apologise to anyone who feels that the been deceived. We are very upset with our supplier this. It is the first time that it has happened in 27 ye business.

We hope that it will be the last.

Gary Johnston
Managing Director

SA $

Stereo Hybrid Amplifier

The output is solid state with a valve preamp stage. This gives it better power output with lower hum an distortion. Two sets of stereo inputs plus separate bass and treble controls.

- Valves: 2 x 6N1, 2 x 6P15
- Power output: 18WRMS per channel
- Input sensitivity: 300mV
- S/N ratio: 80dB
- THD: <0.5%
- 270(W) x 290(D) x 140(H)mm

Was $299

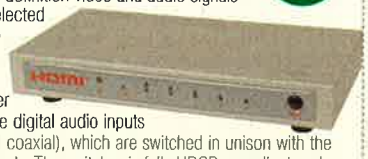
$269 Cat: AA-0

NEW HDMI SWITCHING & ACCESSORIES

5 Input Remote HDMI Switcher

NEW FOR 08

This stylish design five input HDMI selector routes high definition video and audio signals from the selected input to the HDMI output. The switcher also has five digital audio inputs (optical and coaxial), which are switched in unison with the HDMI channels. The switcher is fully HDCP compliant and comes with an infrared remote control. It has a gain control to compensate for long cable runs. Includes mains adaptor.



$99.95 Cat: AC-1693

- Dimensions: 270(W) x 170(D) x 50(H)mm

HDMI 3 Port Switch

NEW FOR 08

This system expander will allow you to hook up, convert and switch between a component video (YPbPr), DVI-Digital, and a HDMI signal to one HDMI v1.3 output. Audio is also combined with the video signal, so you can combine stereo audio or optical digital audio with your YPbPr video source, and DVI-D can be combined with optical digital audio. Includes an IR remote control for ease of use, as well as the mains adaptor.

$149 Cat: AC-1684

MORE INFO AVAILABLE ONLINE

- Dimensions: 258(W) x 120(D) x 28(H)mm

4 Way Active HDMI Splitter

A splitter allows one HDMI output device to be distributed to up to four monitors or projectors. Ideal for conferences, conventions, and presentations or very large home theatre installations.

NEW FOR 08

- Simultaneous display
- Supports 480p, 720p, 1080i, 1080p
- HDCP compliant
- Dimensions: 205(L) x 95(W) x 28(H)mm

$99.95 Cat: AC-1695

2 Input HDMI Switcher

NEW FOR 08

A simple remote controlled device for switching between two High-Definition Multimedia (HDMI) sources. Comes with external IR receiver on a 2m cable, enabling you to hide the switcher out of sight. Powered via the HDMI cable and fully HDCP compliant.

$49.95 Cat: AC-1691

- Dimensions: 80(L) x 55(W) x 17(H)mm

Right Angle HDMI Adaptors

NEW FOR 08

Adapts HDMI plug to socket at right angles. Perfect for wall mounted TV applications. Gold plated connections. Two types available:

Right Angle Down

$9.95 Cat: PA-3646

Right Angle Up

$9.95 Cat: PA-3648

HDMI Extender

NEW FOR 08

This HDMI extender equalises and boosts your HDMI signal so that you can run cable up to 50m long.

- Supports up to 1080p resolution
- Compatible with VGA, SVGA, XGA, SXGA, UXGA
- Automatic equalisation up to 1.6Gbps
- HDMI v1.3 compliant
- Dimensions: 68(L) x 40(W) x 18(H)mm

$49.95 Cat: AC-1697

CAT 5/6 HDMI Extender

One of the disadvantages of HDMI is the limited range of cabling before extenders are needed. This extender allows you to transmit over Cat 5 or 6 cable, thereby significantly reducing cable costs if you need to transmit over long distance. Both unshielded twisted pair (UTP) and shielded twisted pair (STP) cables may be used, however shielded is recommended.

NEW FOR 08

- Dimensions: (sender & receiver): 44(W) x 43(W) x 26(D)mm

$129 Cat: AC-1699

AV HDMI Lead

NEW FOR 08

Type A plug to Type C or 'Mini' HDMI socket cable. For connection to portable HDMI devices.

- 3 metres length.
- Gold plated internal shield
- 24K gold contacts
- Internal dual strain relief
- Triple shielded
- Nitrogen gas injected dielectric
- RoHS compliant
- HDMI v1.3 compliant

$49.95 Cat: WQ-7412

AWARD WINNING CAR AUDIO

Our WINNING 5 Channel Full Range Car Amplifier

This award winning amplifier has four full range channels and a subwoofer channel plus a host of features including adjustable gain and variable high-pass filters.

- Power @ 4ohm 14.4V: 60WRMS x 4ch + 225WRMS x 1 ch
- Power @ 2ohm 14.4V 90WRMS x 4 ch + 340WRMS x 1 ch
- Power Bridged @ 4 ohm 14.4V 180WRMS x 2 ch + 340WRMS x 1 ch

$499 Cat: AA-0458

VENOM Split System Car Speaker

An excellent 2 Way speaker featuring a dome tweeter that can be mounted separately for best performance.

- Nominal impedance 4ohms
- Frequency response: 65Hz - 20kHz
- Power handling: 85WRMS
- Sensitivity: 90dB 1W@ 1m

$69.95 Cat: CS-2389

VENOM Low-Profile Subwoofer

Their huge power handling and cone excursion make these the ideal subs for people who really want massive SPL in a compact package. Nominal imp. 4Ω. Two models available:

10" 250WRMS Cat. CS-2356 **$79.95**

12" 350WRMS Cat. CS-2358 **$99.95**

4 Way AV Component Distribution Amplifier

Offering the extra flexibility of component video, this AV distribution amp allows you to take advantage of HDTV on digital pay-TV and free-to-air. Distributes one set of component and stereo audio inputs to four outputs.

NEW FOR 08

- Mains adaptor included.
- Supports up to 1080p resolution
- 12VDC 500mA power supply
- Dimensions: 190(W) x 90(H) x 23(D)mm

$99.95 Cat: AC-1648

SPEAKER & PLASMA / LCD TV WALL MOUNTING BRACKETS

Adjustable Wall Mounting Speaker Bracket

NEW FOR 08

- Horizontally and vertically adjustable
- Speaker depth adjuster
- Holds speakers 165mm - 300mm deep
- 10kg per bracket
- Sold per pair

$34.95 Cat: CW-2840

If you're getting a Home Theatre system this Christmas don't forget the mounting hardware.

Plasma/LCD TV Wall Bracket - 45kg

NEW FOR 08

This is the baby model, designed for LCD TVs from 23-37" in size and weighing up to 45kg. Despite the low price, it's still solidly made and features a security locking bar. It can be mounted flat or at a fixed tilt angle of 5°, whilst the TV is only spaced 38mm from the wall.

- VESA standard compliant
- Solid steel construction
- Mounting hardware and instructions included

$59.95 Cat: CW-2826

Active 12" 150W Subwoofer

Add this high-performance powered subwoofer to your existing system and add some real kick to your home theatre system. The cabinet is finished in a timber veneer and houses a 12" driver and amplifier. The amp is rated at 150 watts RMS, has auto power-on, level adjustment, crossover frequency adjustment, phase reversal switch, high and line level inputs as well as high and line level outputs. Line level connectors are gold plated RCA while high levels are via spring loaded clips.

NEW FOR 08

- Frequency response: 20 - 150Hz
- Dimensions: 350 (W) x 440 (H) x 420(D)mm

$199 Cat: CS-2457

Jaycar Electronics

Free Call: 1800 022 888 for orders! www.jaycar.com.au

AUDIO SWITCHING

Active Component Video to HDMI Converter

Takes the component video (YPbPr) and digital audio output from your DVD player, set-top box or Digital Pay TV box - and converts them to HDMI.

- Mains adaptor included.
- Dimensions: 90(L) x 68(W) x 25(H)mm

$99 Cat: AC-1607

Converter DVI/Digital Audio to HDMI

Combine a digital DVI video signal and a digital audio signal into a single HDMI lead. Perfect for hooking a media centre PC up to a home theatre system. Also provides digital audio output in both coax and optical formats. Mains adaptor included.

- Dimensions: 125(L) x 100(W) x 25(H)mm

$99 Cat: AC-1608

Active VGA + Audio to HDMI Converter

Takes the VGA output + stereo audio signal from your PC, & converts them to HDMI format whilst maintaining full HD resolution. Mains adaptor included.

- Dimensions: 90(L) x 68(W)x 25(H)mm

$99 Cat: AC-1609

3 Way Audio Selector

Many audio amplifiers don't provide enough inputs for all your components. Takes up to three stereo RCA inputs and provides a single stereo RCA output.

- 3 pairs of RCA inputs
- Dimensions: 133(W) x 42(H) x 85(D)mm

$14.95 Cat: AC-1655

CAT 5 AV EXTENDERS

These allow you to greatly extend your cable range using conventional Cat 5e cable, enabling you to lengthen the propagation distance or pipe your A/V signals over conventional network cable runs. Three types available for complete flexibility:

Component Video $39.95 Cat: QC-3680

Component Video & Digital Audio Cat 5 Extender $44.95 Cat: QC-3682

Composite Video & Stereo Audio Cat 5 Extender $49.95 Cat: QC-3684

Universal Learning Remote with A/C Control

Pre-programmed with thousands of devices, and able to learn and control up to 8 different devices including the air conditioning. It can also be programmed with two macro functions and will retain all your data even if the batteries go flat.

- Backlit LCD
- Low battery indicator
- Audible reminder
- Requires 3 x AAA batteries
- Dimensions: 200(L) x 55(W) x 26(D)mm

$34.95 Cat: AR-1726

NEW PARTY GEAR

Rack Mount Dual MP3 Controller

The convenience of MP3 with the flexibility of full pitch, cue and track controls will add seamless flexibility to your DJ or home studio setup. It accepts two SD cards up to 4GB capacity and gives a huge array of control over every track on each card. The backlit LCDs indicate all functions as they happen.

Features:

- Supports ID3 Tag
- 19" 2U standard size
- Power source: 6VDC 1.5A
- Output: 2V ±0.5dB
- Frequency response: 17Hz - 16kHz
- Dimensions: 483(W) x 88(H) x 78(D)mm

$399 Cat: AA-0492

DJ Mobile 19" Rack Frame

With a total of 18 units available, you'll be able to fit all your rack gear and keep it completely portable. Ideal for DJs, PA techs, sound engineers or guitarists with large rack setups. The top section can be rotated through a range of 45° for maximum flexibility. Sturdy steel construction with castors.

- Steel construction
- Hardware included
- Dimensions: 530(W) x 1050(H) x 500(D)mm

*Equipment not included.

$79.95 Cat: HB-6348

Portable Combo 30W PA Amp with USB

This busker's amp has a USB port as well as the normal mic/audio inputs, so you can plug in a memory stick and play backing or rhythm tracks in your performance. In addition, you can connect an MP3 player or CD player to the line level inputs via the RCA sockets. It has a built-in rechargeable battery that gives you 3-5 hours of use or it can be mains powered.

- Separate volume control on USB channel
- Battery or mains powered
- 3 channel mixer
- Dimensions: 245(W) x 280(H) x 245(D)

$249 Cat: CS-2519

19" Rack Mount Road Case

The ideal accessory for DJs or anyone whose job demands easy transportation and setup of music equipment. The interior of this case allows rack mounting for amplifiers and can be opened at both ends for simple access to rear cables or panel settings.

- Internal 19" rack mounting
- Dimensions: 633(L) x 505(H)mm x 270(D)mm

$129.95 Cat: HB-6347

WIRELESS MICROPHONE SYSTEMS

Wireless Microphone UHF Dual Channel

A two-channel system supporting two separate microphones. Each channel has a separately balanced XLR output. A single unbalanced (mixed) line output is also available. The system includes two microphones and batteries, receiver unit and plugpack.

- Wireless range: 60m
- Frequency response: 40Hz - 18kHz
- 210mm wide

$199 Cat: AM-4078

Wireless Microphone Belt Pack

Add a lapel clip wireless mic to your set-up. The transmitter clips to your belt or fits into your pocket. Suitable for wireless receivers AM-4077 and AM-4079.

- Requires 9V battery
- Transmission range: 100 metres max
- Frequency: 16 Channels, 770-800MHz
- Dimensions: 95(H) x 62(W) x 22(D)mm

$129 Cat: AM-4076

AUDIO VIDEO SENDERS

2.4GHz AV Sender/Receiver

Send your audio and video all over the house wirelessly on the 2.4GHz band.
Use your cable TV, CD, DVD remote to change channels, volume and settings from the receiver end of this 2.4GHz system. Send stereo audio and video pictures around your home, shop or office, allowing you to watch video or listen to hi-fi quality stereo sound anywhere. Send surveillance camera images to another part of the building.
All without the need to run cables.
Features a phase-locked loop (PLL) electronic circuit that constantly adjusts, locking onto any input signal and avoiding any reception drift.

$69.95 Cat: AR-1836

Spare Receiver also available for AR-1837 $39.95

Dual Channel AV Sender

Allows you to connect two AV sources to the transmitter, share them around the house, and select either of them from the other room, without the hassle of running wires all over the house. The sender operates in the 2.4GHz band for audio and video signals and at 433MHz for the infrared remote control repeater function. The sender can be connected to any two devices such as your TV, Hi-Fi sound system, video recorder, DVD player, set top box, or cable TV system. A selector button on the receiver allows selection between the two connected devices.

$89.95 Cat: AR-1838

Spare Receiver also available for AR-1839 $49.95

PIC Based Water Tank Level Meter Kit

Refer: Silicon Chip Magazine November 2007

This PIC-based unit uses a pressure sensor to monitor water level and will display tank level via an RGB LED at the press of a button.

The kit can be expanded to include an optional wireless remote display panel that can monitor up to ten separate tanks (KC-5461) or you can add a wireless remote controlled mains power switch (KC-5462) to control remote water pumps.

Kit includes: electronic components, case, screen printed PCB and pressure sensor.

$99.95 Cat: KC-5460

Telemetry Base Station for Water Tank Level Meter

Refer: Silicon Chip Magazine January 2008

$79.95 Cat: KC-5461

This Base Station is intended for use with the telemetry version of the KC-5460 water tank level meter. It has an inbuilt 433MHz wireless receiver and can handle data transmissions from up to 10 level meters and display the results on a 2-line 32-character LCD module. Includes transmitter upgrade for one tank level meter. Kit includes PCB and all electronic components.

LED Water Level Indicator MKII Kit

Refer: Silicon Chip Magazine July 2007

This clever circuit illuminates a string of LEDs to indicate the water level in a rainwater tank. Kit supplied with screen printed PCB and all electronic components.

- Requires 20mm PVC hose/pipe (length require depending on tank depth)
- Requires 12-18V AC or DC plugpack

$3

Digital Fuel Mixture Display

Refer: Silicon Chip Magazine September 2000

Monitor you car's air: fuel ratio in real time.

This brilliant dashboard-mounting unit monitors and displays your car's air-fuel ratio in real time on a three-digit display, as well as a bargraph for readings at a glance. It indicates air: fuel ratio in real time 11.8 - 20.6 for petrol, and 12.7-21.5 for propane/LPG. It has loads of great features. Check out our website for full details. Kit includes: case with silk-screened panel, PCBs, pre-programmed PIC micro, 7-segment displays, red acrylic, hook-up wire and all electronic components.

$62.95 Cat: KC-5300

UHF Remote Controlled Mains Switch

Ref Silicon Chip February 2008

Commercial remote control mains switches are available but these are generally limited to a range of less than 20m. This UHF system will operate up to 200m and is perfect for remote power control systems etc. The switch can be activated using the included hand held controller or our KC-5461 water tank level sensor base station. Kit supplied with case, screen printed PCB, RF modules and all electronic components.

$99.95 Cat: KC-5462

Keycase Mini Driver Set

Handy set of mini bits and driver in a convenient key-sized storage case.

- Slotted: 1.5, 2, 2.5mm
- Phillips: 0, 00, 000
- Torx: T5, T6, T7, T10
- TN8, Hex 2.5mm
- Case size: 95(H) x 60(W)mm

NEW FOR 08

$14.95 Cat: TD-2105

CIRCULAR CONNECTORS

M8 Circular Connectors

NEW FOR 08

Commonly used in process control instrumentation. All connectors are field installable.

M8 3 Way Plug $18.90 Cat: PP-4300

M8 4 Way Plug $19.95 Cat: PP-4302

M8 3 Way Socket $21.50 Cat: PS-4301

M8 4 Way Socket $22.50 Cat: PS-4303

Mixed Velcro Cable Ties Pk16

Keep your cables neat and tidy. Packet of 16 velcro cable ties in assorted sizes from 125 to 180mm.

GLUE

Super Glue 15ml

NEW FOR 08

Super glue in a handy 15ml bottle for hobby or industrial use. Bonds plastics, metals, wood, rubber, glass, metal and ceramics.

$3.95 Cat: NA-1506

25ml Metal Epoxy

Two-part metal epoxy. Bonds ferrous and non-ferrous metals including steel, stainless steel, aluminium, copper, brass and iron. Convenient 25ml syringe pack for accurate mixing. Fast setting and cures to a grey colour.

Epoxy Repair Putty 28g

Repair wood, brick, concrete plastics, ceramics or composites. You can also fabricate or mould small parts. Simply cut off as much as you need, knead together to mix. It has an open time of about 5 minutes and cures in about an hour. Storage tube included so it doesn't dry ut before you use it.

$5.95 Cat: NA-1520

IP54 Rated 150mm Digital Caliper

Soluble oil, grease, dust and swarf are just some of the hazards measurement tools have to deal with in a workshop. These calipers are IP54 rated to withstand all these nasties.

NEW FOR 08

$59.95 Cat: TD-2084

- Resolution: 0.01mm
- Auto power-off
- Metric and Imperial conversion in any position
- Case included
- Battery included

Solder Fume Extractor

NEW FOR 08

Designed to remove dangerous solder fumes from the work area. Suitable for use in production lines, service centres, R&D workbenches or the hobbyist. It incorporates a ball bearing high volume fan to maximise airflow, which is directed upwards at the rear of the unit to aid in safe dispersion of fumes. ESD safe.

$69.95 Cat: TS-1580

- Dimensions: 260(H) x 200(W) x 170(D)

DIGITAL MULITIME

CAT IV Autoranging Pocket DMM

An advanced pocket sized DMM that is suitable for serious work. It features detachable leads, capacitance and frequency ranges as well as a CATIII rating and non-contact voltage detection.

SAVE $5

- AC & DC voltage: 600V
- AC & DC current: 200mA
- Resistance: 40Mohms
- Capacitance: 100µF
- Frequency: 100kHz
- Diode test
- Continuity test
- Dimensions: 120(L) x 55(W) x 40(D)mm

$44.95 Cat: QM-1542 **Was $49.95**

IP67 Rated Cat III Autoranging DMM

Trade quality DMM, with integrated moulded holster. Features include analogue bargraph display, backlit LCD, auto power-off & low battery indication.

- 61 segment analogue display
- Relative mode • Data hold
- Diode test • Audible continuity
- Min/max storage mode • True RMS
- Auto or manual range
- AC & DC voltage: 600V
- AC & DC current: 10A
- Resistance, capitance & temperature
- Holster included

$79.95 Cat: QM-1325

50

True RMS CAT IV Digital Multimeter

This rugged meter is designed for professional use & will many years of reliable service. It measures up to 1,000 volts AC & DC & is rated to CAT IV 600. It includes temperature & capacitance ranges, as well as peak-hold & min/max options. It is water & dust-proof (IP67) & features a double moulded case that will easily withstand a 2m fall. Includes K-type thermocouple.

- Display: 40,000 count
- Basic accuracy: 1%
- AC & DC current: 10A
- Resistance: 40Mohms
- Capacitance: 40µF • Frequency: 100MHz
- Dimensions: 187(H) x 81(W) x 50(D)mm

$169 Cat: QM-1543

FM TRANSMITTERS

Hands Free Bluetooth MP3 Player

NEW FOR 08

You can listen to your favourite MP3 tracks through your car's FM radio and pair it with your Bluetooth-enabled mobile phone - it will transmit voice call signals so if a call comes through, the music stops while you're talking hands-free on the phone. Tracks can be loaded from a USB drive or SD/MMC card or connect to a iPod®, CD player or other device.

- Dimensions: 70(H) x 50(W) x 22(D)mm

$89.95 Cat: AR-1862

Remote Control Car MP3 Player

Like the other media players on the range, this one plugs into the cigarette lighter outlet in your car so you can play MP3 or WMA tracks through the FM tuner in your car stereo. You can control it with the front panel, the remote unit or the steering-wheel mounted IR remote.

NEW FOR 08

- 2.5-3.5mm stereo cable included
- Supports SD/MMC or USB
- Supported audio formats: MP3, WMA
- Measures: 70(H) x 50(W) x 22(D)mm

$49.95 Cat: AR-1865

Wireless MP3 Modulator For In-Car Use

SAVE $10

Powered from your car's cigarette lighter socket, this nifty gizmo enables you to play MP3 files from your USB flash drive or SD card on your car's FM radio. The LCD displays the track playing and transmission frequency. It also has a patch lead so you can connect it to your MP3 player, CD player or other audio device.

- Last track & last used frequency memory
- 200 transmission frequencies ***Was $49.95***

$39.95 Cat: AR-3114

Remote Control Car Media Player

Watch movies on your in-car TFT monitor or listen to your favourite MP3 tracks on your FM radio. Simply plug into your car cigarette lighter outlet and connect to your monitor's A/V input, or transmit the audio by FM to your stereo.

- Measures: 70(H) x 50(W) x 22(D)mm

NEW FOR 08

$79.95 Cat: AR-1867

Intelligent 12V 6A Switchmode SLA Battery Charger

Maintain your battery in top condition with this intelligent 12V SLA mains charger. The charger features LED status indicators and incorporates a four stage charging system that automatically switches to maintenance mode once the charge is complete. Fully protected.

- Dimensions: 175 (W) x 140(L) x 50(H)mm

$119.95 Cat: MB-3624

Universal Battery Charger with Status Display

NEW FOR 08

Li-ion/Li-polymer

This breakthrough product is cleverly designed with an adjustable battery tray to accept almost any standard 1 or 2 cell rechargeable Li-ion/Li-polymer battery. The unit has automatic battery voltage and polarity sensing as well as bad battery detection. The charger is supplied with both mains and car adaptors.

- Adjustable charging current 400/800mA
- Size: 143(L) x 64(W) x 30(H)mm

$39.95 Cat: MB-3587

Surge Protectors

Mains surge protectors are a must for protecting valuable equipment against damage. Unknown to the majority of consumers, the voltage coming out of the power point can and will fluctuate daily, even without major occurrences like lightning strikes. These two mains surge protectors alleviate the majority of problems caused by these increases in voltage which damage delicate and expensive appliances connected to your power outlets.

SAVE $5

Main Surge Protector ***Was $14.95***

$9.95 Cat: MS-4018

SAVE $5

Mains Surge & Telephone Line Protectors ***Was $19.95***

$14.95 Cat: MS-4019

38 Channel UHF CB Twin Pack

This 2 pack of mini UHF CB communicators can keep you clearly in touch up to 3km. They feature electronic volume control, monitor functions and an integrated blue LED torch.

- 38 Channels
- Requires 3 x AAA batteries per unit

*Sold as a pair

$49.95 Cat: DC-1005

LED TORCHES

Weatherproof 130 Lumen CREE® Head Torch

With up to 130 lumens from a single CREE® LED, this head torch is far brighter than most hand-held torches. Three modes - high, low and flashing.

NEW FOR 08

- Battery level indicator LED
- Secure screw-lock closure
- Gasket sealed
- Output: HI - 130 lumens
  Lo - 80 lumens
- Requires 3 x AAA batteries

$49.95 Cat: ST-3284

60W Regulated Car Power Adaptor

Designed for just about any modern electronic device, this adaptor will power MP3 players, games, CD players, appliances or anything else that requires 5 - 12VDC at up to 5A. It's also fuse protected and includes four plug adaptors to suit most popular devices.

- Fuse protected
- Lead length: 1400mm

NEW FOR 08

$34.95 Cat: MP-3478

38 Channel CB Transceiver

NEW FOR 08

This lightweight hand-held transceiver is suitable for all manner of professional and recreational activities such as hiking, boating, kayaking, building sites, IT-cablers, electricians, inter-car road trip communication or farming, etc. Open field transmission range is up to 5km, with typical city range up to one kilometre.

- Green backlit LCD screen
- Range up to 5km
- No licence required
- Uses 4 x AAA
- Dimensions: 105(H) x 60(W) x 35(D)mm

$39.95 Cat: DC-1023

1.5 Watt LED Torch

SAVE $10

This 1.5W LED torch has a rugged matt finished to reflect its toughness and robust application. Durable and water resistant, it contains a 1.5W LED to produce a super bright output. It also has a specially designed magnifying lens to produce a more focused beam for precise illumination.

- 2.5 hour battery life
- 2 x AA batteries (included)
- Comes in nylon pouch and carry strap
- Weighs: 133g
- Size: 173 (L) x 26 (Dia.)mm ***Was $49.95***

$39.95 Cat: ST-3332

Mini LED Torches

These keyring torches contain a coloured Light Emitting Diode (LED) to produce a bright light at a touch of a button. Great for parties and discos.

- Uses 3 x 1.5V silver oxide 392 included (for replacement batteries use our SB-2502)
- 45(D) x 10(W) x 10(H)mm

- Blue ST-3380
- White ST-3382
- Red ST-3384

$3.95 Per each

Wireless Digital Rain Gauge with Anemometer

Keep track of important weather parameters like wind speed and rainfall. It also has a calendar and a clock with alarm function. In addition, it measures indoor and outdoor temperature and humidity.

- Clock, calendar and alarm
- Wind speed in km/h or mph
- Max min and rainfall history in mm or inches
- Temperature in Celsius or Fahrenheit
- Requires 2 x AA and 2 x AAA batteries
- Display: 180(H) x 104(W) x 24(D)mm

$99.95 Cat: XC-0338

In-Car Rechargeable 12V LED Torch

Keep this portable LED optic light in your car, caravan or boat. Simply plug the optic light into a 12 volt cigarette lighter socket to recharge in a couple of hours. A cool blue led glows to indicate recharge mode, it also has built-in fuse protection.

- Size: 125(L) x 25(Dia)mm

$14.95 Cat: ST-3360

51

200W 12VDC WIND TURBINE

Always at the forefront of alternative energy technology, we're pleased to offer this new range of wind turbine generators.

NEW FOR 08

As well as the 200W model shown here we now have a super-compact 300W version (see page 1), and a big 500W unit for those who want to generate some serious power.

- Rated Power: 200W
- Max Power: 300W
- Output Voltage: 12VDC

*No mounting hardware, poles or guide wires included.

Spare Parts Also Available:
- **12VDC Control Box**
- **Turbine Blades for Wind Generator - Pack of 3**

$399 Cat: MG-4520

Rechargeable 35W HID Spotlight

NEW FOR 08

Has far longer bulb life, uses less energy and is much brighter. With a pounding 3300 lumens, this spotlight is ideally suited to search and rescue, boating, professional shooters, security or other high-power applications. It's housed in a tough weather-resistant ABS housing and has a handy shoulder strap for extended use. The built-in rechargeable battery gives about 50 minutes of continuous use and it recharges either from the mains plugpack or a car cigarette lighter socket.

$149 Cat: ST-3369

- 12V, 35W
- Battery: 12V 7Ah rechargeable lead acid battery
- Mains adaptor: 15VDC 500mA
- Dimensions: 300(L) x 210(Dia)mm

Due mid November

Solar Hydrogen Generation Kit

Learn all about the finer points of hydrogen and solar-generated emission-free energy. The kit contains everything you need to get your own solar hydrogen experiment up and running. Instant renewable energy - just add distilled water.

Kit contents:
- 1 watt solar panel, connecting cables, 0.3 watt fuel cell, hydrogen and oxygen tanks, gas container, tubing and syringe
- Comprehensive instruction booklet
- Solar panel size: 155(L) x 125(W)mm
- Recommended for ages 12 yrs+

$99.95 Cat: KT-2524

Car Kettle

Plug into your car's cigarette lighter socket and boil away. Holds up to 550ml and is suitable for tea, coffee, soup or any other hot beverage.

- 2 cups, strainer & mounting bracket included
- Dimensions: 235(H) x 95(Dia)mm

$15.95 Cat: GH-1380

INDUSTRIAL STORAGE CASES

NEW FOR 08

These units are made from sturdy ABS with solid clasps and removable compartment trays so you can take parts with you to any job.

Two sizes available:

Industrial 15 Compartment Storage Case

12 compartments:
55(L) x 40(W) x 50(D)mm
3 compartments:
80(L) x 50(W) x 50(D)mm
Case size: 335(L) x 205(W) x 60(D)mm

$9.95 Cat: HB-6304

Industrial 19 Compartment Storage Case

4 compartments:
55(L) x 40(W) x 50(D)mm
8 compartments:
80(L) x 50(W) x 50(D)mm
7 compartments:
110(L) x 80(W) x 50(D)mm
Case size: 335(L) x 205(W) x 60(D)mm.

$19.95 Cat: HB-6305

LED LIGHTING

Rite Light Round Pucks

Simple one touch operation and super bright LEDs make this the most versatile and easy to install light you'll ever purchase. No need for cords or plugs.

Lights are battery operated

Requires 3 x AAA batteries
- 5 LEDs
- 2 lighting modes
- Measures: 90mm Dia.

$9.95 Cat: ST-3165

Rite Light Square
- 6 LEDs
- 2 adjustable angled light blocks
- Measures: 100 x 100mm

$14.95 Cat: ST-3166

Rite Light Rectangle
- 6 LEDs
- Rotating light tube
- Measures: 220(L) x 56(W) x 30(H)mm

$14.95 Cat: ST-3167

Lighting System

High efficiency self contained solar lighting system
An excellent kit that comes with everything you need to build an efficient solar lighting system. Supplied with automatic solar panel, lamps, battery, connecting cable, fuse and switch. The perfect camping companion.
- 12V 8Ah SLA battery
- 10 Watt solar panel
- Panel size: 458(L) x 458(W) x 34(D)mm

$199 Cat: MP-4552

As reviewed in Silicon Chip November 08

Ultra-Low Distortion 135WRMS Amplifier Module

Ref Silicon Chip August 2008

This ultra low distortion amplifier module uses the new ThermalTrak power transistors and is largely based on the high-performance Class-A amplifier. This improved circuit has no need for a quiescent current adjustment or a Vbe multiplier transistor and has an exceptionally low distortion figure. Kit supplied with PCB and all electronic components. Heat sink and power supply not included.

NEW FOR 08

- Output Power: 135WRMS into 8ohms and 200WRMS into 4ohms
- Frequency Response at 1W: 4Hz to 50kHz
- Harmonic Distortion: <.008% from 20Hz to 20kHz

$89.95 Cat: KC-5470

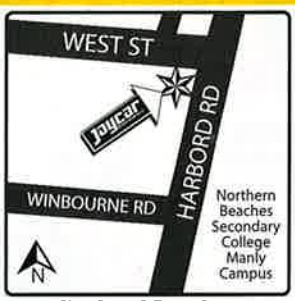
Power Supply Kit for Ultra-LD Mk2 200W Amplifier

Ref Silicon Chip September 2008

The amp module (KC-5470) is powered using an unregulated rail only. This power supply kit is specifically designed to provide a balanced +/- 55VDC supply to power this fantastic amp kit. It has two LED's, which illuminate when power is present on the rails and the assist in slowly discharging the filter caps when power is switched off.
- Kit includes PCB and all electronic components.

$54.95 Cat: KC-5471

NEW BROOKVALE STORE



208 Harbord Road
Brookvale NSW 2100
Phone: (02) 9905 4130

YOUR LOCAL JAYCAR STORE

Australia Freecall Orders: Ph 1800 022 888

NEW SOUTH WALES	
Albury	Ph (02) 6021 6788
Alexandria	Ph (02) 9699 4699
Bankstown	Ph (02) 9709 2822
Blacktown	Ph (02) 9678 9669
Bondi Junction	Ph (02) 9369 3899
Brookvale	Ph (02) 9905 4130
Campbelltown	Ph (02) 4620 7155
Erina	Ph (02) 4365 3433
Gore Hill	Ph (02) 9439 4799
Hornsby	Ph (02) 9476 6221
Liverpool	Ph (02) 9821 3100
Newcastle	Ph (02) 4965 3799
Penrith	Ph (02) 4721 8337
Rydalmere	Ph (02) 8832 3121
Sydney City	Ph (02) 9267 1614
Taren Point	Ph (02) 9531 7033
Tweed Heads	Ph (07) 5524 6566
Wollongong	Ph (02) 4226 7089
VICTORIA	
Coburg	Ph (03) 9384 1811
Frankston	Ph (03) 9781 4100
Geelong	Ph (03) 5221 5800
Melbourne	Ph (03) 9663 2030
Ringwood	Ph (03) 9870 9053
Springvale	Ph (03) 9547 1022
Sunshine	Ph (03) 9310 8066
Thomastown	Ph (03) 9465 3333
QUEENSLAND	
Aspley	Ph (07) 3863 0099
Cairns	Ph (07) 4041 6747
Ipswich	Ph (07) 3282 5800
Maroochydore	Ph (07) 5479 3511
Mermaid Beach	Ph (07) 5526 6722
Townsville	Ph (07) 4772 5022
Underwood	Ph (07) 3841 4888
Woolloongabba	Ph (07) 3393 0777
AUSTRALIAN CAPITAL TERRITORY	
Belconnen	Ph (02) 6253 5700
Fyshwick	Ph (02) 6239 1801
TASMANIA	
Hobart	Ph (03) 6272 9955
SOUTH AUSTRALIA	
Adelaide	Ph (08) 8231 7355
Clovelly Park	Ph (08) 8276 6901
Gepps Cross	Ph (08) 8262 3200
WESTERN AUSTRALIA	
Maddington	Ph (08) 9493 4300
Midland	Ph (08) 9250 8200
Northbridge	Ph (08) 9328 8252
Rockingham	Ph (08) 9592 8000
NORTHERN TERRITORY	
Darwin	Ph (08) 8948 4043
NEW ZEALAND	
Christchurch	Ph (03) 379 1662
Dunedin	Ph (03) 471 7934
Glenfield	Ph (09) 444 4628
Hamilton	Ph (07) 846 0177
Hastings	Ph (06) 876 0239
Manukau	Ph (09) 263 6241
Newmarket	Ph (09) 377 6421
Palmerston Nth	Ph (06) 353 8246
Wellington	Ph (04) 801 9005
Freecall Orders	Ph 0800 452 922

Prices valid to 30th November 2008

Jaycar Electronics

Jaycar Electronics Free Call: 1800 022 888 for orders! www.jaycar.com.au

CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.

Phone mute for PA sound system

This circuit was developed to mute the sound from a PA system in a warehouse, so that when the phone rings, the workers can hear it. This was accomplished without any need for a physical connection to the phone line. Instead, it makes use of the fact that a LED lights on the phone when there is an incoming call. So whenever the LED flashes, the sound circuit is muted.

The circuit works as follows: with no incoming calls, the LED on the phone is unlit and so the adjacent light dependent resistor (LDR1) is in darkness and its resistance is very high. LDR1 is connected in the base circuit of transistor Q1 so that when LDR1 is high in resistance, the transistor is off.

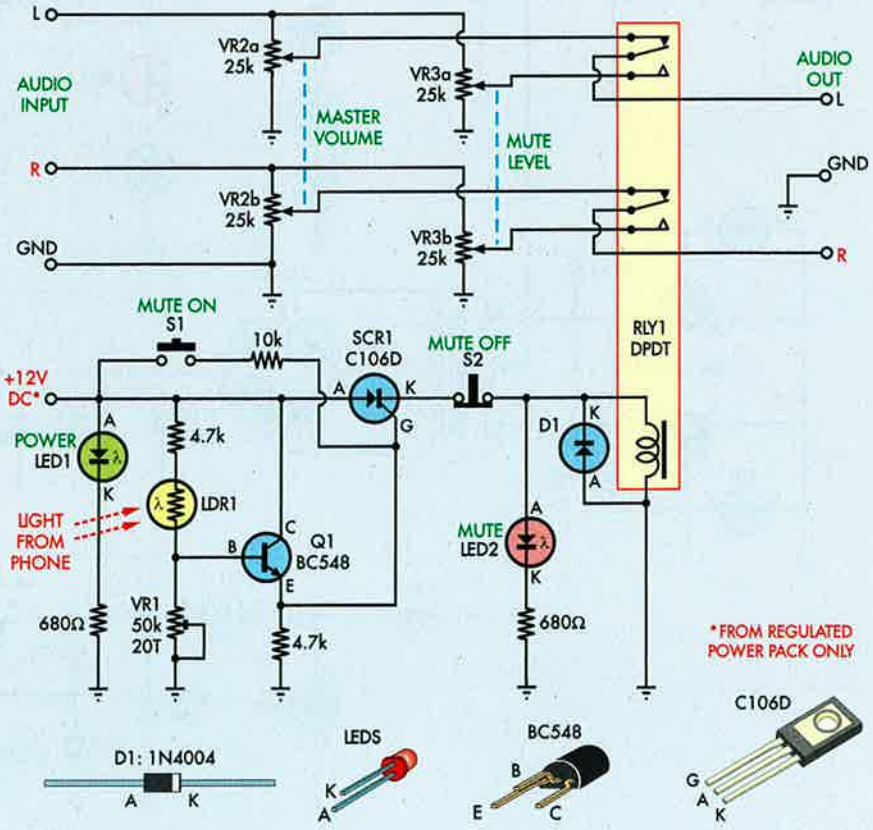
When the LED of the phone flashes to indicate an incoming call, its light falls on LDR1 and causes its resistance to drop markedly. This turns on Q1 which then pulls the gate of SCR1 high to trigger it into conduction. This energises relay RLY1 to mute the stereo signal to the sound system via its DPDT contacts. Multi-turn trimpot VR1 is used as a sensitivity control.

The LDR is mounted in a piece of heatshrink tubing and held in place over the phone LED with some hot-melt glue. Most phones have a light of some sort which comes on when it rings. Sometimes it's an LCD screen which lights up and this circuit is sensitive enough to work from that as well.

The system stays muted until the "mute off" is pressed to break the circuit and return the SCR to the non-conducting state. The "mute on" switch can also be pressed at any time to mute the system, feeding a small gate current to the SCR via a 10kΩ resistor. A high-intensity red LED (LED2) indicates when it is actually muted.

Dual-gang potentiometers VR2 and VR3 are used to set the level of the sound system when it is operating and when muted, respectively.

Ron Russo,
Townsville, Qld. ($50)



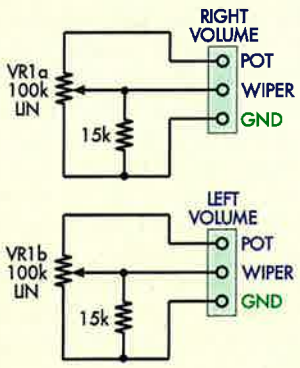
Converting a linear pot to a log curve

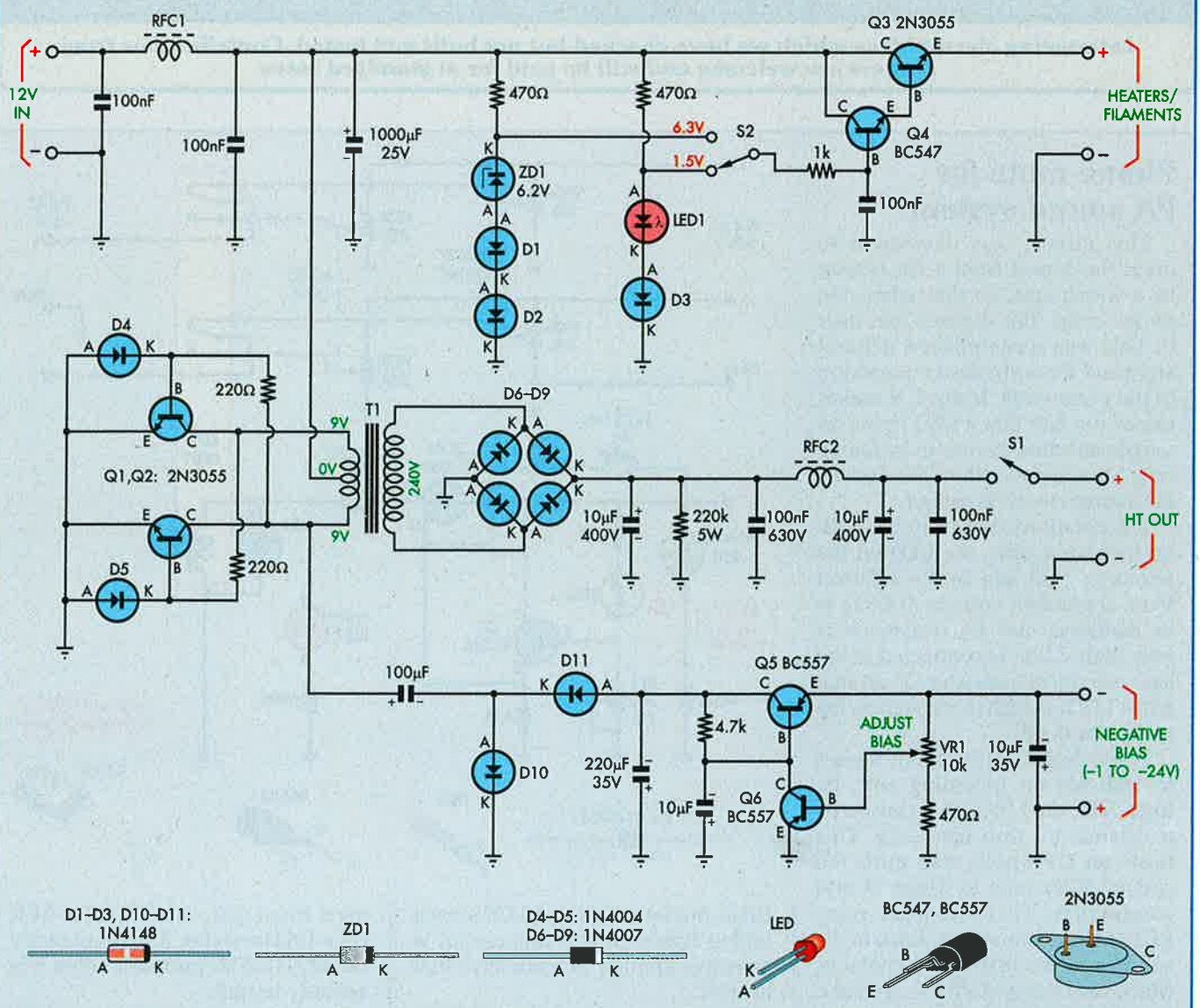
Quite often you may need a log pot but you only have a linear type in your stock. This can be particularly frustrating if the wanted pot is a dual-ganged type for an audio application.

However, by connecting a resistor between the low (GND) side of the pot and its wiper it is possible to get a reasonable approximation of the logarithmic curve. In the example shown, we have used 15kΩ resistors with a 100kΩ dual-gang potentiometer to form a stereo volume control.

Other values of potentiometer should have about the same ratio of resistor value to potentiometer value. For example, for a 50kΩ pot, use a 6.8kΩ or 7.5kΩ resistor.

SILICON CHIP.





12V inverter runs high-voltage supply

This inverter-based supply was developed to run valve amplifier and radio circuits. It would be ideal for vintage radio enthusiasts. It will provide an HT (high tension) current of 20-30mA at several hundred volts. It also has an adjustable negative bias supply and a filament (heater) DC supply of a few amps, switchable to 1.5V or 6.3V.

Two 2N3055 power transistors, Q1 & Q2, are connected as a multivibrator to drive the 9V windings of a 240V power transformer. The stepped up supply is rectified by bridge diodes D6-D9 and filtered by a 10µF 300V capacitor. Additional hash filtering is provided by inductor RFC2 in conjunction with another 10µF 300V capacitor and a 100nF capacitor. A 220kΩ 5W resistor across the supply acts as a "bleed" resistor to improve regulation.

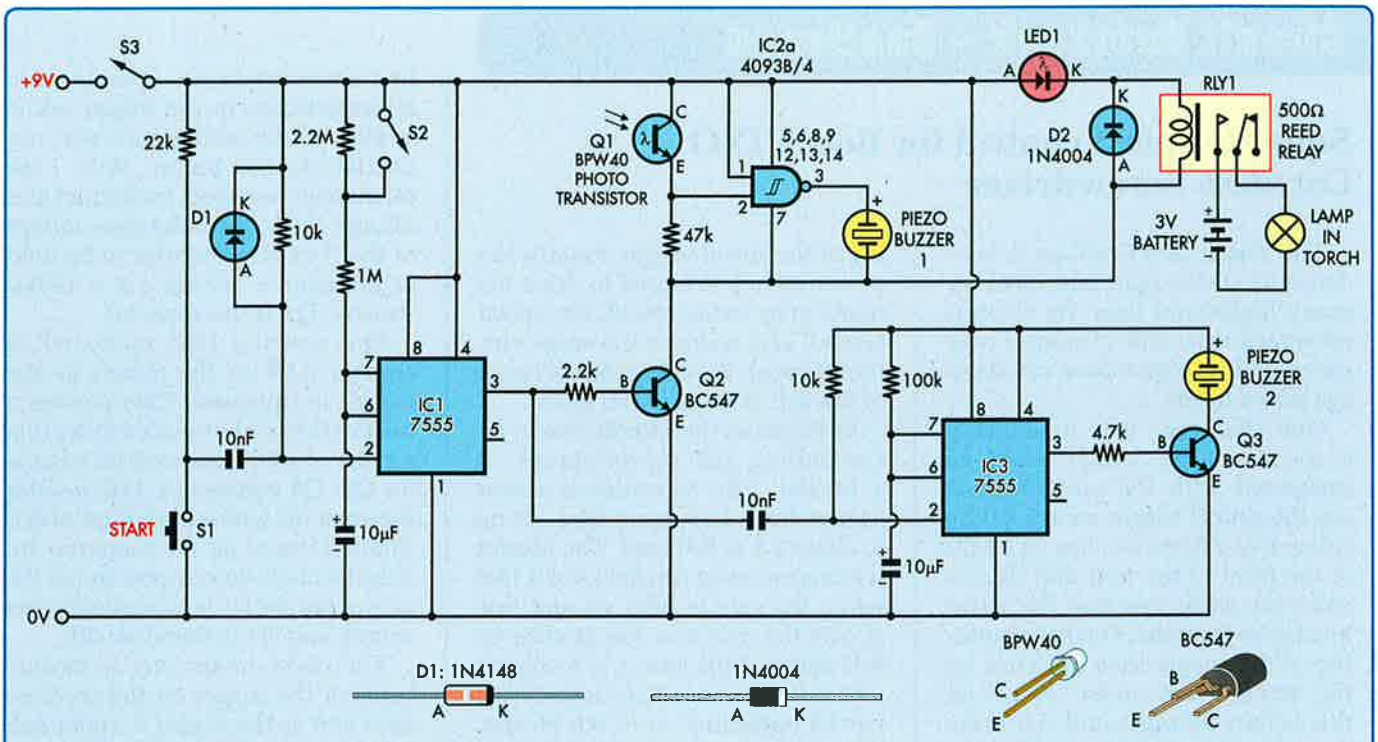
The negative bias supply is derived from the 9V primary winding which feeds diodes D10 & D11, in conjunction with 100µF and 220µF capacitors, connected as a half-wave "diode pump". The resulting negative DC voltage is fed to an adjustable discrete regulator consisting of transistors Q5 & Q6.

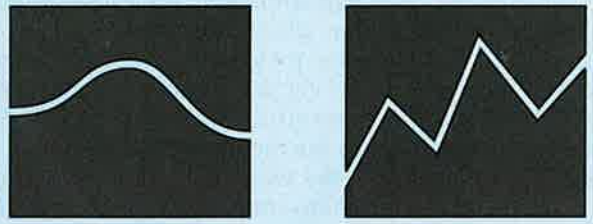
Q6 acts as a rudimentary error amplifier and the regulator output is adjusted by trimpot VR1 to give a voltage between -1V and -24V.

The filament (heater) supply is derived from the 12V DC input via another discrete regulator circuit consisting of transistors Q4 & Q3. These are connected as a Darlington emitter follower with Q4's base voltage set by diode strings to give a switchable output voltage of 1.5V or 6.3V. Q3 will require a heatsink.

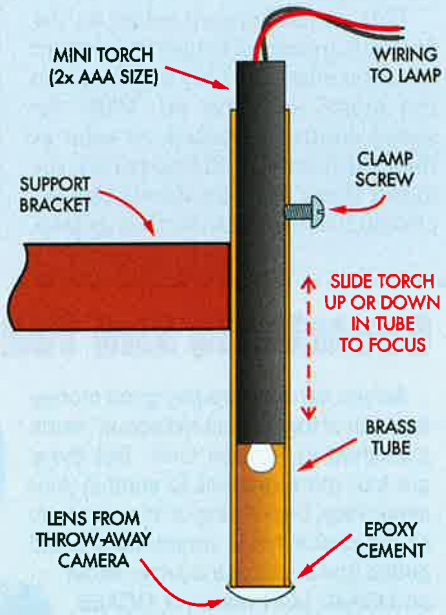
The entire circuit is powered by a 12V DC plugpack with a rating of several amps. The two inductors, RFC1 & RFC2, were miniature ferrite toroids with about 20-turn windings and were salvaged from defunct power supplies.

Dayle Edwards,
Taylorville, NZ. ($65)





SAMPLE TARGETS



Exerciser for manual dexterity

This device was designed for use by disabled children to develop manual dexterity but it could be a useful game for all children.

A shallow box measuring about 270 x 270 x 15mm sits on a table. In the centre of the top is a 7mm hole. A torch and lens/tube is set on a rigid bracket about 120mm above the box, to project a spot of light through the 7mm hole. Sitting on the box is one of several "targets" which are 200mm squares of white Perspex painted all over except for a rambling track which runs from one side to the other.

The child has to manoeuvre the target from one side to the other so that the light spot always stays on the translucent track. If it wanders off, a beep is heard. A time limit applies and then a buzzer sounds. The tracks can be tapered or made wide or narrow, to make the task more or less demanding.

To start the game, switch S1 is pressed and this triggers 7555 timer IC1 which is a configured as a monostable to give a time limit of 10 or 33 seconds depending on whether switch S2 is open or closed. Pin 3 of IC1 goes high to turn on transistor Q2 which applies power to IC2 and to relay RLY1 which switches on the torch.

Below the hole is phototransistor Q1 upon which the light beam is focussed. If the light is unobstructed by the target (ie, passes through to Q1), both pins 1 & 2 of NAND Schmitt trigger IC2a are high and its output at pin 3 is low. Conversely, if the light is blocked by the target, the Q1's resistance suddenly goes high and pin 2 of IC2a is pulled low by a 47kΩ resistor. This causes pin 3 of IC2a to go high and piezo buzzer 1 sounds. This will happen each time the light is blocked by the target.

When the time limit set by IC1 expires, its pin 3 output goes low to turn off the relay and torch as well as IC2. In addition, monostable timer IC3 is triggered to briefly sound piezo buzzer 2 (pick one with a different tone) to indicate that the game has ended. A new game is started when switch S1 is pressed again.

A. J. Lowe,
Bardon, Qld. ($50)

Squeeze speed control for Bosch IXO Cordless Screwdriver

The Bosch IXO Cordless Screwdriver is small, light and ideal for many household uses. Its obvious drawback is its lack of control over speed and its high torque can damage screw heads.

Our challenge was to develop a speed control which could be integrated with the unit. Squeezing the on/off trigger switch of the screwdriver first switches on a LED at the front of the unit that illuminates the work area over the screw head to be fastened. Further squeezing of the trigger then switches on the screwdriver motor. However, this occurs abruptly and can make the screwdriver bit jump out of the screw head.

This control circuit relies on the few millimetres of trigger movement between when the LED is on to when the motor switches on. With the speed control installed, as soon as the illumination LED comes on, the motor starts to move slowly and increases in speed with further squeezing of the speed trigger. Finally, the power switch is closed to drive the motor at its fastest speed. The speed control also reduces the surge current through the on-switch because of the soft starting of the motor.

In essence, the circuit works by controlling the on-resistance of a Mosfet. The screwdriver motor draws about 1.3A at no load, rising to about 2A at full load. The Mosfet we use has an on resistance of 0.16Ω when the gate is fully on and this allows the motor to run at close to full speed. Full speed is available when the power switch closes. With partial switching on of the Mosfet, the resistance is higher and the motor runs slower.

Power for the circuit is a nominal 3.6V from the lithium battery and this is not sufficient to drive a standard Mosfet. Instead, our circuit uses use a P-channel Mosfet (Q1) which is turned on fully by a gate to source voltage of 3.5V.

Operation is as follows: the cordless screwdriver incorporates two microswitches in the trigger while another slider switch reverses connection to the motor. With both microswitches open, transistor Q2 is off and this allows the gate voltage of the P-channel Mosfet to be held at the source voltage via a 100kΩ resistor. Q1 is therefore off.

The existing LED microswitch applies 3.6V to the circuit as the trigger is squeezed. This powers a LED within a photo-interrupter (via a 120Ω resistor) and turns on transistor Q2. Q2 connects a 1kΩ resistor between the gate and ground of Q1. The LED turns on the transistor inside the photo-interrupter and so the gate of Mosfet Q1 is held close to the source and Q1 is therefore off.

The photo-interrupter is located beneath the trigger on the cordless drill and as the trigger is squeezed, it begins to progressively block the light applied to the transistor inside the photo-interrupter. Hence, the gate of Mosfet Q1 is pulled towards 0V via the 1kΩ resistor and Q2. As a result, Q1 begins to switch on and so the motor starts to run.

As more light is blocked in the photo-interrupter, the motor speeds up until Mosfet Q1 is fully on. At

Contribute And You Could Win One Of The Instruments

As you can see, we pay good money for each of the "Circuit Notebook" items published in SILICON CHIP. But there are four more reasons to send in your circuit idea. Depending on the ingenuity of the circuit, your contribution could entitle you to choose a prize: either an LCR40 LCR meter, a DCA55 Semiconductor Component Analyser, an ESR60 Equivalent Series Resistance Analyser or an SCR100 Thyristor & Triac Analyser, with the compliments of Peak Electronic Design Ltd **www.peakelec.co.uk**

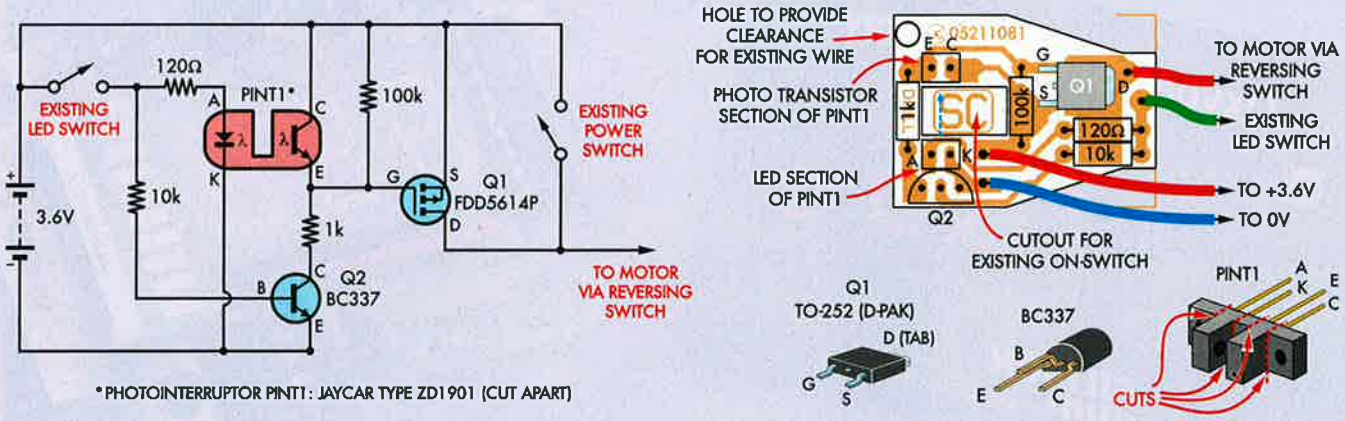
So now you have even more reasons to send that brilliant circuit in. Send it to SILICON CHIP and you could be a winner.

You can either email your idea to silchip@siliconchip.com.au or post it to PO Box 139, Collaroy, NSW 2097.

Issues Getting Dog-Eared?

Keep your copies safe with these handy binders.

Available Aust. only. Price: $A13.95 plus $7 p&p per order (includes GST). Just fill in and mail the handy order form in this issue; or fax (02) 9939 2648; or call (02) 9939 3295 and quote your credit card number.



*PHOTOINTERRUPTOR PINT1: JAYCAR TYPE ZD1901 (CUT APART)

this point, the second (ie, power) microswitch closes and the motor is driven directly via the switch.

We have designed a PC board to fit on top of the existing drill speed controller board, while a rectangular cut-out in the PC board fits over the existing on-switch. This PC board is used with the copper side up so that the surface-mount Mosfet can be soldered in place. The photo-interrupter is cut to separate the LED and phototransistor sections – see diagram.

Note that the mounting flanges and the piece that interconnects the LED and phototransistor in the photo-interrupter need to be cut off and filed so that the two pieces can straddle the microswitch. The two sections are placed on either side of the microswitch cut-out.

Note also that with the copper side up, it is a little hard to solder the photo-interrupter parts but it can be done if they are raised slightly off the PC board.

The section of moulding within the hand trigger that presses against the microswitch is used to form the light interrupter. The positioning and height of the LED and phototransistor must be adjusted so that they line up correctly. The height affects the way the speed works, with a higher positioning having an earlier speed control effect.

Modifications to the original PC board in the screwdriver include replacing two wire links on its topside with insulated links on the other side. This is to allow the new PC board to sit flat onto the original PC board. In addition, the positive and negative leads from the battery are removed and inserted through both the new PC board and into the original PC board to apply power. Two extra wires are required, one for the motor reversing switch, and this can be found on the existing on-switch terminal. The second wire goes to the existing LED microswitch terminal. Connections to these microswitches must be to the switched side, not the 3.6V side.

The FDD5614P Mosfet is available from **www.farnellinone.com.au** (Cat. 9846131). It needs a small heatsink fashioned from some copper sheet. This can be soldered to the tab of the Mosfet and bent over the top of the SMD package.

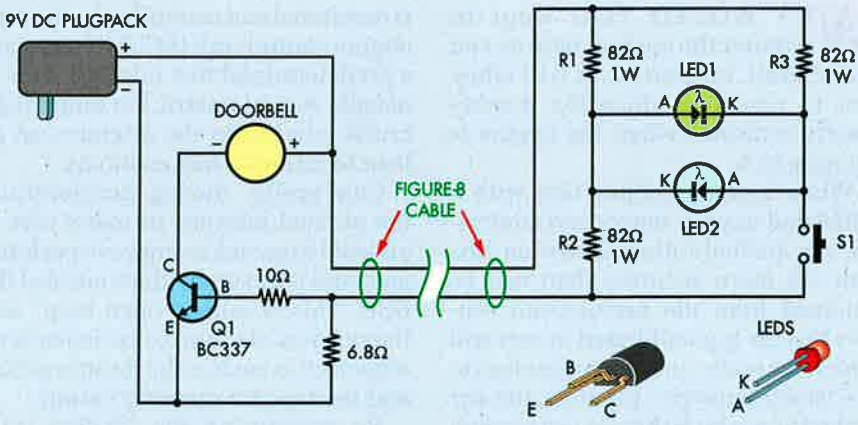
The add-on PC board is coded 05211081 and will be available from RCS Radio Pty Ltd. Phone (02) 9738 0330, **www.rcsradio.com.au**

John Clarke
SILICON CHIP.

Vandal-proof bell button for entry gate

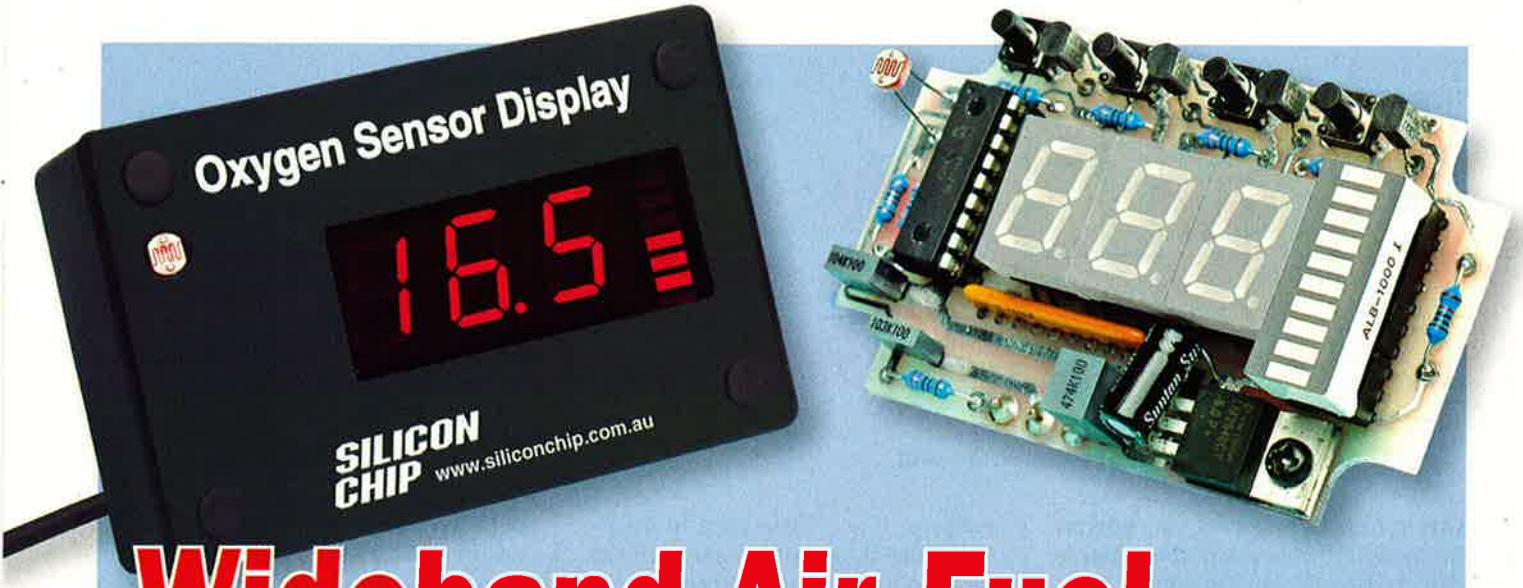
One of the drawbacks of UHF remote switches used for entry gates is that they can be easily damaged by the weather or simply stolen. This circuit relies on the more conventional approach, with a switch at the gate connected to the doorbell by underground figure-8 cable.

It employs a stainless-steel vandal-proof switch with daylight-viewable dual colour LEDs (available from Farnell Electronics). Normally the circuit is set to turn on blue LED2, with current flowing from the positive supply via two 82Ω resistors (R3 and R2) and the 6.8Ω base resistor for transistor Q1. Since the blue LED has a forward voltage of around 3.5V, only about the 40mA flows and this is not enough to bias on Q1.



When switch S1 is pressed, current momentarily flows through 82Ω resistor R1 to light green LED1. This also turns on Q1 which then turns on the doorbell.

Leigh Bateman,
Brendale, Qld. ($40)



Wideband Air-Fuel Mixture Display

By JOHN CLARKE

Monitor your car's air/fuel ratio as you drive

This Wideband Oxygen Sensor Display can show your car's air-fuel ratio as you drive. It's designed to monitor a wideband oxygen sensor and its associated wideband controller but could be used to monitor a narrowband oxygen sensor instead. Alternatively, it can be used for monitoring other types of engine sensors.

WHY WOULD YOU want to monitor the air/fuel ratio as you drive? Well, for starters, it will allow you to save fuel since the display clearly indicates when the engine is running rich.

When used in conjunction with a wideband oxygen sensor and controller, the air/fuel ratios shown on this unit are more accurate than can be obtained from the narrowband sensors that are typically used in cars and which are really only accurate close to the "stoichiometric" point (ie, the air/fuel ratio at which there is just enough oxygen in the air to ensure complete combustion).

Under normal driving, most engine management systems operate under "closed loop" control. This is where the air/fuel ratio from an oxygen sensor is monitored and controlled by the car's engine control unit (ECU) to maintain a predetermined fuel mixture. This is usually stoichiometric but under light cruise conditions the mixture can go lean to improve fuel economy.

Conversely, during acceleration, the air/fuel mixture in many cars is allowed to go rich to improve performance and is not under the control of the ECU. This is called "open loop" and the richness of the mixture depends on other factors such as the throttle setting and the injector opening period.

By monitoring the air/fuel mixture display as you drive, you will quickly learn how to obtain the best economy. When climbing a hill, for example when the car would normally be running rich, you can ease off on the throttle just enough to return the ECU to closed-loop control and run at stoichiometric mixtures to reduce the amount of fuel used.

In addition, when gear changes are required, you may find that changing earlier or later than normal will keep the engine running leaner for longer.

Similarly, when travelling downhill without throttle, most cars shut off the injectors above a certain RPM limit, so that no fuel is used at all. When this happens, the display will show a very lean air/fuel ratio.

Note, however, that the injectors are usually partially open below this RPM limit, to ensure a smooth engine response when the throttle is opened. This means that when travelling downhill, it may be better to drop down a gear to ensure complete injector shut-off (and thus reduced fuel

usage), rather than stay in a higher gear with the injectors slightly open.

Diagnosing problems

Once you've used this unit for awhile, you will soon learn what sort of readings to expect in every-day driving. Any subsequent variations from "normal" can then be interpreted as indicating a problem. For example, there could be a fault with the oxygen sensor, the wideband controller or the engine management unit. A problem with fuel delivery is another possibility.

Oxygen sensors do wear out eventually, due to an accumulation of contaminants on the sensor tip. As a result, car manufacturers recommend that they be replaced after a specified number of kilometres (typically around 100,000km for a heated sensor type). A worn-out oxygen sensor becomes sluggish in its response and causes a number of problems including excessive fuel consumption, poor engine performance, accelerated catalytic converter damage and increased emissions.

By monitoring your car's air/fuel ratio as you drive, you can quickly discover abnormal operating conditions and have the sensor checked and, if necessary, replaced.

Engine modifications

This unit will also be invaluable if you are a car modification enthusiast. It will soon show whether or not the mixture is too lean during acceleration or too rich under cruise conditions and allow you to make adjustments accordingly.

This can be particularly handy if you are swapping the ECU chip for an aftermarket type or if you are experimenting with the fuel injectors. It's all too easy to damage an engine if the mixture is too lean under certain circumstances.

Oxygen sensor types

In order to monitor the air/fuel ratio, the vehicle must be fitted with an oxygen sensor. These are fitted to all vehicles that have fuel injection and engine management, although most cars use what is known as a "narrowband" oxygen sensor.

For a detailed explanation on how oxygen sensors work and a description of the two basic types, refer to the article "Narrowband & Wideband Oxygen Sensors" on page 27 of this issue.

Main Features & Specifications

MAIN FEATURES

- 3-digit LED display plus 7-segment bargraph.
- Linear display with 0-5V wideband range or 0-1V S-curve range.
- Alternative display switching (A or B readings for wideband values); petrol or LPG readings for narrowband S-curve.
- 0V and 5V endpoint value limit adjustments for both A and B displays.
- Decimal point positioning.
- Display leading zero suppression.
- Bargraph can be operated in dot, bar or centred-bar mode for wideband range. S-curve set-up allows for dot or centred bar styles.
- Display dimming with minimum brightness and dimming threshold adjustments.
- Quieting period used for input measurement to ensure accuracy.

SPECIFICATIONS

Power Supply: 6-15V @ 240mA (full display brightness)

Input Current Loading: less than ±1μA

Digit Update Period: 250ms

Bargraph Update Period: 30ms

Wideband Display Reading Range: 0-999

Narrowband Display Reading Range: 11.8 to 20.6 for unleaded petrol with the stoichiometric ratio set for 14.7; 12.6 to 21.4 for LPG with stoichiometric at 15.5. The display shows an "L" for ratios below the lowest value and an "r" for ratios above the highest value.

In practice, the oxygen sensor is located in the exhaust system to monitor the exhaust gas after the fuel has been burnt in the engine. Basically, the fuel is mixed with air inside each cylinder prior to firing. This air/fuel ratio is varied under the control of the ECU in order to obtain the desired engine (and emissions) performance.

Under light engine-load conditions, the engine is usually run with exactly the correct proportion of fuel and air to ensure complete combustion. When this happens, the air/fuel ratio is said to be "stoichiometric" and this ratio is typically 14.7 for unleaded petrol. Putting it another way, 14.7kg of air is mixed with each 1kg of the unleaded fuel to achieve the stoichiometric ratio.

Note, however, that the stoichiometric ratio is different for different fuels because it depends on the chemical composition of the fuel and its combustion characteristics. For liquid petroleum gas (LPG), the stoichiometric

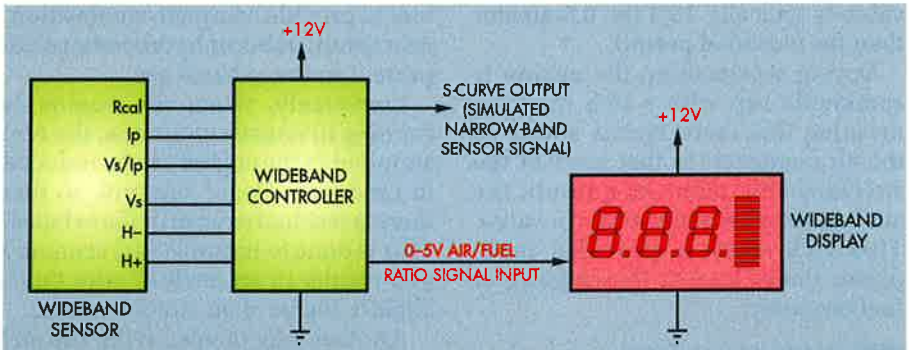


Fig.1: here's how the display unit is used with a wideband sensor and its associated controller. The narrowband S-curve output from the controller is fed to the engine management computer (see text).

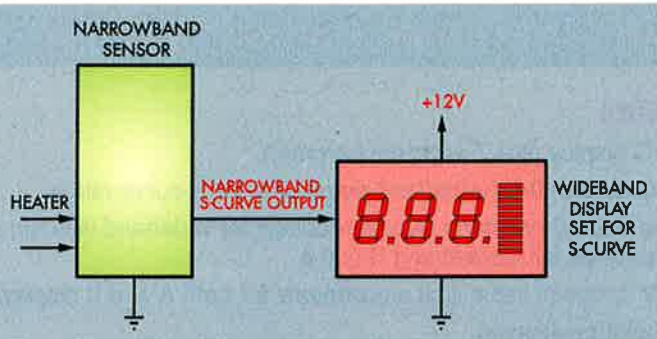


Fig.2: the original narrowband sensor fitted to the car can be used to directly drive the display unit if accuracy isn't important. The display must be set to run in S-curve mode.

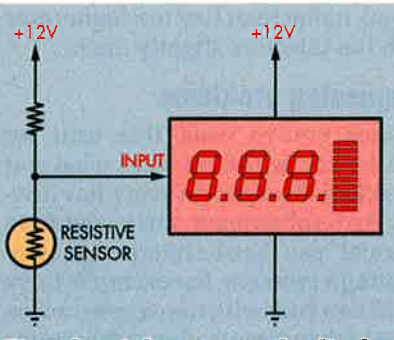


Fig.3: here's how to use the display unit with a resistive sensor (eg, a temperature gauge).

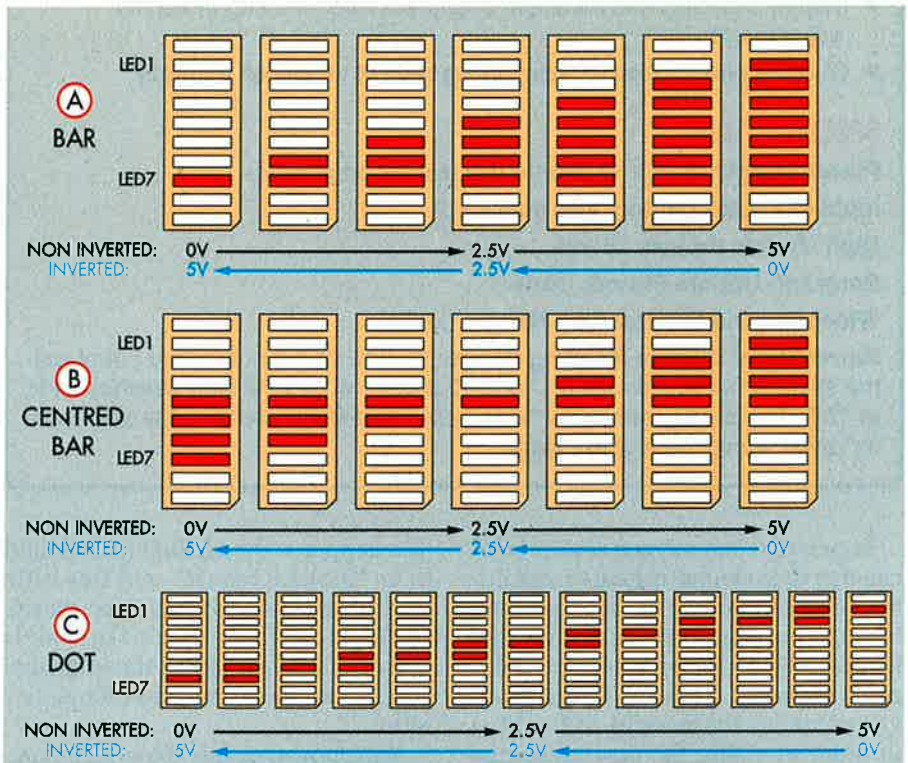


Fig.4: this diagram shows the bargraph display options that are available when the display unit is operating in wideband mode: (a) bar; (b) centred bar; and (c) 13-step dot. In each case, the bargraph can also operate in inverted mode.

value is typically 15.5 (ie, 0.8 greater than for unleaded petrol).

During acceleration, the engine is commonly run with a rich mixture, meaning that more fuel is added to the air compared to that used in the stoichiometric ratio. As a result, the air/fuel ratio becomes lower in value. This rich mixture provides more power under load at the expense of fuel economy.

Unburnt hydrocarbons

When the mixture is rich, there is insufficient oxygen in the air/fuel mixture to provide complete combustion. As a result, unburnt hydrocarbons are present in the exhaust gas.

Conversely, when the engine is running in cruise conditions, the fuel supplied to the engine can be reduced to produce a "lean" mixture, so that there is residual oxygen in the exhaust. This is done to improve fuel economy and results in an air/fuel ratio that's slightly higher than stoichiometric.

Another way of specifying the air/fuel ratio is to "normalise" the stoichiometric value so the ratio is referenced to 1. We call this normalisation the "lambda" (λ) value and it has a value of "1" at the stoichiometric point.

Basically, the Lambda value is simply the actual air/fuel ratio divided by the stoichiometric ratio. This means that lean air/fuel ratios have a lambda greater than 1, while rich air/fuel ratios have a lambda that's less than 1.

In practice, air/fuel ratios are a compromise between driveability, engine power and the production of air pollutants. Air pollutants are also reduced using a catalytic converter. This converts nitrous oxides to nitrogen and oxygen, carbon monoxide (CO) to carbon dioxide (CO_2) and the unburnt hydrocarbons into carbon dioxide and water.

Oxygen sensor display unit

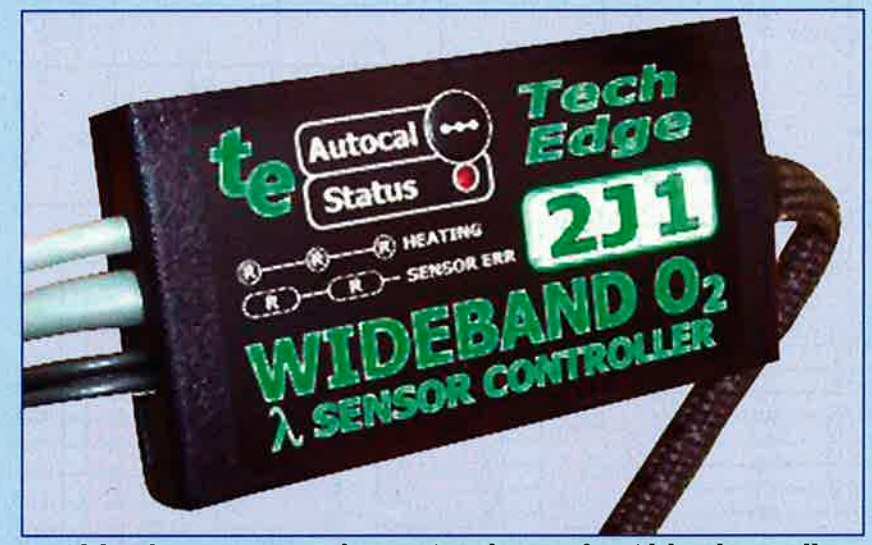
As shown in the photos, the SILICON CHIP Oxygen Sensor Display unit is housed in a small plastic case. It features a 3-digit LED display to show the air/fuel ratio plus a 7-segment bargraph which indicates the signal trend.

Just three leads are used to connect the unit to you car: one for 12V power, another for the ground and the third for the signal. In addition, two more leads can be wired to switch the unit from one set of display values to another.

Inside the box are four pushbutton switches located along the top edge of the PC board. These are used to initially set up the way the unit works. However, they are not normally used once the various settings have been made.

Another feature of the unit is automatic display brightness. During daylight, the displays are driven to full brightness so that they can be easily seen. By contrast, as the ambient light dims, the display brightness is reduced so that they don't become

What Type Of Oxygen Sensor To Use



A wideband oxygen sensor also requires the use of a wideband controller unit, such as this Tech edge WB02 2J1. It provides a 0-5V output which is fed to the Oxygen Sensor Display unit, plus a simulated narrowband S-curve output that's fed to the engine management computer.

VIRTUALLY ALL CARS come fitted with narrowband oxygen sensors and if you want to save money and accuracy isn't important, you can use the existing sensor with the SILICON CHIP Oxygen Sensor Display. That said, it's best to substitute the Bosch LSU11 narrowband oxygen sensor, since the display unit is calibrated for this sensor in narrowband mode.

Conversely, if you want high accuracy, you must use a wideband oxygen sensor such as the Bosch LSU 4.2. This must be teamed with a wideband controller that gives a 0-5V output. Such controllers include the Tech Edge WB02 2J1 (**http://wbo2.com/home/products.htm**) and the Innovate Motosports LC-1 (**http://www.innovatemotorsports.com/products.php**). Alternatively, we intend to publish a wideband controller in a future issue of SILICON CHIP.

At present, there are only a few vehicles such as Audi and VW that have factory-fitted wideband sensors, so the chances are that you will have to buy a wideband sensor and fit it. In most cases, all you have to do is remove the existing narrowband sensor, substitute the wideband sensor and team it with a wideband controller. The simulated narrowband S-curve output from the wideband controller is then connected to the vehicle's engine management computer. This replaces the signal from the original narrowband sensor and allows the engine to operate normally – see Fig.1.

The 0-5V output from the wideband controller unit is connected to the display unit which then provides accurate air/fuel mixture readings.

distracting, particularly at night.

Fig.1 shows how the unit is used with a wideband sensor and its associated controller. As can be seen, the 0-5V output from the controller provides the air/fuel ratio signal for the Oxygen Sensor Display. In addition, a wideband controller usually has a simulated S-curve output and this can be used to replace the signal from the original narrowband sensor for the engine management computer.

By using the 0-5V signal from the controller, the display unit can be set up to show the air/fuel ratio over a set range. For example, it could be set to show air/fuel ratios between 7.4 and 22.0. These values are set to match the 0-5V range from the wideband controller, with the unit responding in a linear fashion.

That's not all it can do though. Basically, this unit can be set to display what ever values you wish. For ex-

DEAD DEVICE UNDER TEST?
NO PROBLEM!
ABI BoardMaster 8000 Plus

Features:
• 64 to 128 Channels Digital V-I Tester
• Analogue/ Digital as wired in-circuit testers
• Power On/Off testing

THE MOST COMPREHENSIVE TEST SET FOR FAULT-FINDING ON ALMOST ANY KIND OF PCB

TM TekMark
TekMark Australia Pty Ltd
Suite 302, Level 3, 18-20 Orion Road
Lane Cove - NSW 2066 - Australia
Ph: 02 9911 3888 Fax: 02 9418 8485
enquiries@tekmarkgroup.com
www.tekmark.net.au

Dynalite
Control Systems
POSITION VACANT
SENIOR ELECTRONICS DESIGN ENGINEER

Have a proven record in designing Analogue, Digital & Power Electronics for 7 years or more?

Willing to manage projects and supervise Junior Engineers?

This will be a perfect career opportunity for you in Sydney.

To apply, visit "careers" on

www.dynalite.com.au

or email your resume and cover letter to hr@dynalite.com.au

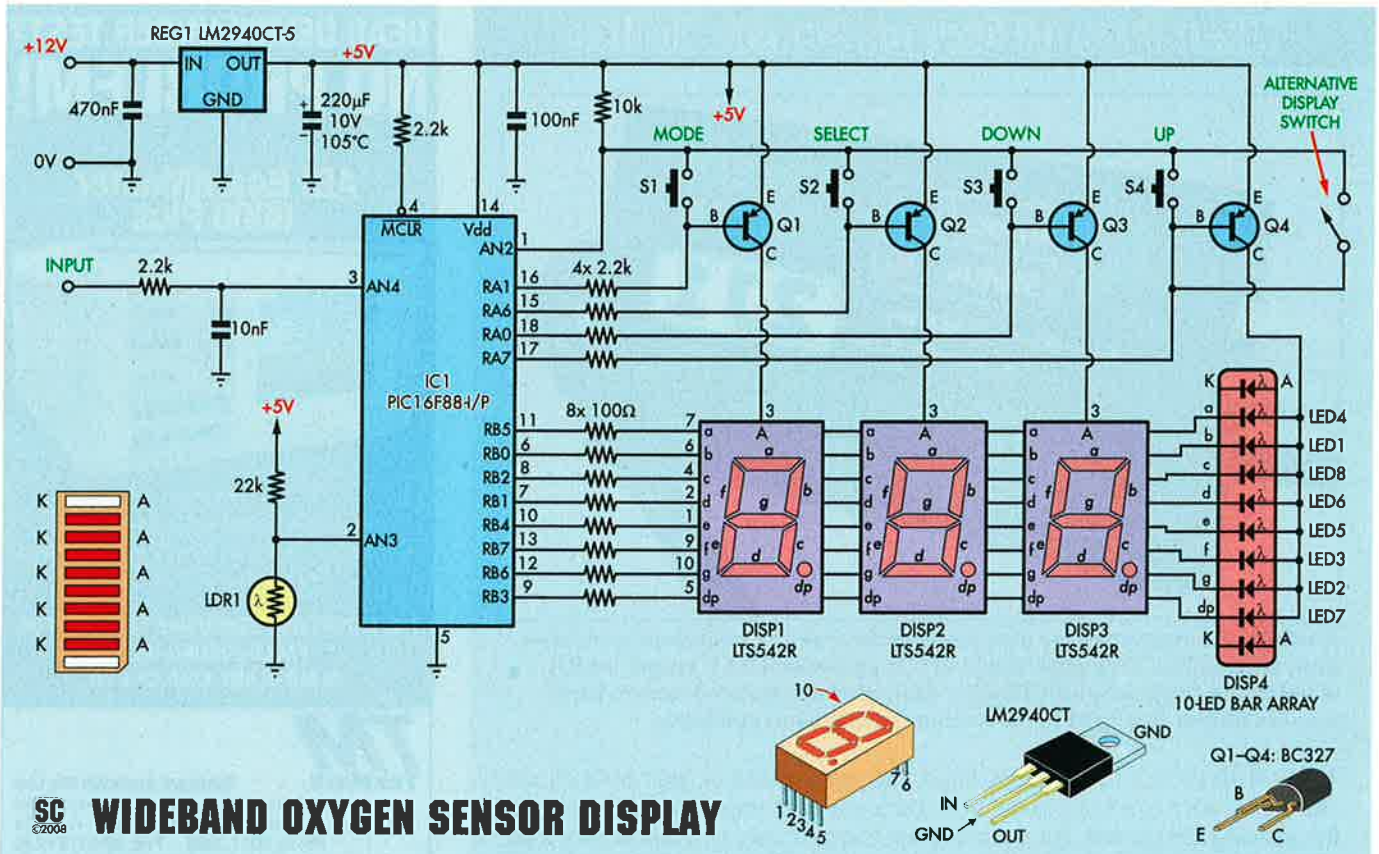


Fig.5: the circuit is based on a PIC16F88-I/P microcontroller (IC1). This processes the sensor signal at its AN4 (pin 3) input and drives three 7-segment LED displays and an 8-LED bargraph in multiplex fashion.

ample, it could be set to show lambda values from say 0.51 to 1.50 instead.

Alternatively, you can set it up to display either the air/fuel ratio or the lambda value at the flick of a switch. In that case, there are two sets of values labelled "A" and "B" and you select between them.

Similarly, for cars that run on both unleaded petrol and LPG, it's possible to switch the unit so that it displays the correct air/fuel ratio for the selected fuel.

Narrowband sensor

Fig.2 shows how the unit is used with a narrowband oxygen sensor. In this case, the display includes a preset response for the standard Bosch LSU11 narrowband oxygen sensor and shows the air/fuel ratio for unleaded petrol from 11.8 to 20.6 (stoichiometric at 14.7).

For air/fuel ratios below 11.8, the display shows an "r" for rich while ratios above 20.6 give an "L" for lean. Similarly, for LPG, the range is 12.6 to 21.4 (stoichiometric at 15.5), with an "r" shown for ratios below 12.6 and an "L" for ratios above 21.4.

One option here is to have a dot or a centred bargraph display for the S-curve narrowband mode. For more information on this, refer to the panel titled "Using The Unit With A Narrowband Sensor".

If the output from the sensor does not cover the full 0-5V range, then the values set at the 0V and 5V end points are obtained by extrapolation. This involves first drawing a graph similar to Fig.9 or Fig.10 that shows two points that correspond to the output from the sensor and their corresponding values. The graph is then extended until it reaches the 0V and 5V points.

The values that are obtained at the 0V and 5V points are the endpoint values that need to be entered into the display during the setting up procedure.

Bargraph display

As indicated previously, the LED bargraph shows the sensor the voltage level and is useful for indicating the voltage trend. Its response to voltage changes is significantly faster than that of the digital display which is deliberately slowed down so that the values can be easily read.

Fig.4 shows the three bargraph display options that are available in the wideband operating mode. Note that although a 10-LED bargraph display is used, only seven LEDs are used in these displays.

Fig.4(a) shows the "Bar" display mode. Here, the number of LEDs lit increases from one to seven over six steps in response to a rising sensor voltage. Alternatively, it can be set up to increase the number of LEDs lit in response to a falling sensor voltage (ie, an inverted display).

The "Centred Bar" mode is displayed in Fig.4(b). In this mode, the centre bar is always lit (2.5V sensor output), with the bar then extending either up or down in response to a rising or falling sensor voltage. Once again, an inverted display option is available.

This option is the most useful when showing the air/fuel ratio, with the bars indicating as the mixture moves into either rich or lean ratios. The centre bar is the stoichiometric point.

Finally, Fig.1(c) shows the "Dot" mode option. In this case, there are

Using It As A General-Purpose Display

BECAUSE IT'S BASED on a microcontroller, this unit can also be used as a general-purpose display to monitor other sensors (ie, you don't have to use it with an oxygen sensor).

Basically, it can display any number ranging from 0-999 in response to any sensor with a 0-5V output signal. You can set it up so that the display either increases in value as the sensor output voltage increases or set it so that the display decreases in response to rising sensor voltages. A decimal point can also be included and can be positioned after the first or second digit.

If no decimal point is selected, then the display features leading zero blanking. This means that a value of 007, for example, will be displayed as 7, while a value of 021 will be displayed as 21. Similarly, if the decimal point is positioned after the second digit, a value of say 00.2 will be shown as 0.2.

This decimal point selection and zero blanking feature also applies when displaying air/fuel ratios from a wideband controller.

13 levels, with either one or two LEDs being lit as the sensor voltage varies. As with the previous two modes, an inverted display option is available.

Circuit details

Despite its versatility, the circuit for the Wideband Oxygen Sensor Display is really very simple. Fig.5 shows the details.

As shown, it's based on a PIC16F88-I/P microcontroller (IC1), with most of the clever stuff hidden inside its firmware program. Apart from that, there are the three 7-segment LED displays (DISP1-DISP4), the 10-LED bargraph display, four driver transistors (Q1-Q4), a 3-terminal regulator (REG1) and a few sundry bits and pieces.

IC1's monitors the input voltage from the sensor, processes the data and drives the LED displays to show the calculated air/fuel ratio value. Output ports RB0-RB7 drive the display segment cathodes, while transistors Q1-Q4 switch the common display anodes, ie, the displays are multiplexed so that only one display digit is driven at any given time.

Note that all the segments common to each display are tied together. For example, the "a" segment of DISP1 connects to the "a" segments of DISP2 and DISP3. In addition, LED4 within the LED bargraph (DISP4) also connects to the "a" segments of DISP1-DISP3.

These "a" segments are driven via the RB5 output of IC1 via a 100Ω resistor. As a result, when this output is low, the "a" segment in one display will light, depending on which driver transistor is turned on.

PNP transistors Q1-Q4 are driven by ports RA0, RA1, RA6 & RA7 via 2.2kΩ resistors. For example, transistor Q1 is controlled by RA1 and when this output is high, Q1 is held off.

Conversely, when RA1 goes low (0V), Q1's base is pulled low via its 2.2kΩ resistor and so Q1 turns on. As a result, any segments within DISP1 that have their cathodes pulled low via IC1's RB outputs (and their respective 100Ω resistors) will now light.

Transistors Q2, Q3 and Q4 are driven in a similar manner to Q1 to control DISP2, DISP3 and the LED bargraph (DISP4). For example, to light DISP2, we switch off Q1, set the required segment driver outputs required for the DISP2 display and then switch on Q2 by taking RA6 low. A similar process is then used to switch on DISP3 and DISP4 in turn.

This on-off switching of the displays is done at such a fast rate (around 2kHz) that the displays all appear to be continuously lit.

Display dimming

Light dependent resistor LDR1 is used to sense the ambient light to control the display dimming. This is connected in series with a 22kΩ resistor to form a voltage divider across the +5V rail and its output is fed to IC1's AN3 port.

When the ambient light is high, the LDR has a low resistance and the voltage at the AN3 input is pulled down close to 0V. Conversely, in low ambient light, the LDR has a high resistance and IC1's AN3 input is pulled close to the +5V rail via the 22kΩ resistor. At intermediate light levels, AN3 will sit somewhere between 0V and +5V.

In operation, IC1 dims the displays in response to its AN3 voltage. It does this by limiting the amount of time that the displays are lit. In bright light, each display is lit for almost 25% of the total time but this reduces as the AN3 voltage rises in response to falling light levels.

In fact, at very low levels, each display might only be lit for about 2% of the time.

Pushbutton switches

Switches S1-S4 allow the unit to be

Parts List

1 PC board, code 05311081, 80 x 50mm
1 plastic case measuring 83 x 54 x 31mm
1 rectangular piece of red clear Perspex 48 x 18mm
4 SPDT micro tactile switches with a 6mm actuator (S1-S4)
1 LDR with 48kΩ light resistance
1 DIP20 IC socket, 0.3-inch width
1 DIP18 IC socket
1 DIP16 IC socket
1 DIP14 IC socket
1 M3 x 10mm screw
1M3 nut
5 PC stakes
1 2m length of twin shielded wire

Semiconductors
1 PIC16F88-I/P microcontroller coded with 0531108A.hex (IC1)
3 13mm common anode LED displays (DISP1-DISP3)
1 10-LED DIL bargraph (DISP4)
4 BC327 transistors (Q1-Q4)
1 LM2940CT-5, +5V low dropout regulator (REG1)

Capacitors
1 220µF 10V electrolytic
1 470nF MKT polyester
1 100nF MKT polyester
1 10nF MKT polyester

Resistors (0.25W, 1%)
6 2.2kΩ
1 10kΩ
1 22kΩ
1 5 x 100Ω individual SIL resistor array
1 3 x 100Ω individual SIL resistor array

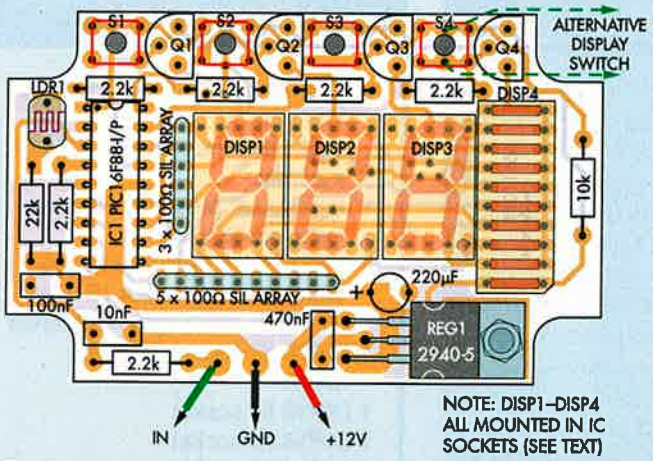
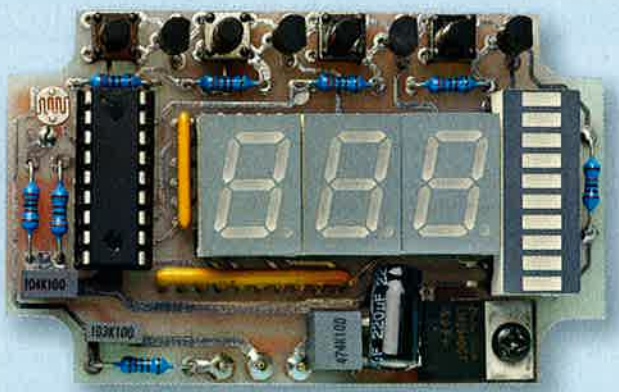
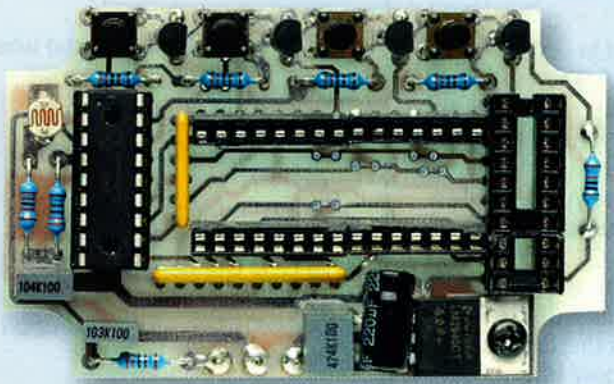


Fig.6: install the parts on the PC board as shown here. The alternative display switch is optional (see text).



Take care to ensure that all the parts are installed on the PC board with the correct orientation. The LED bargraph is mounted with its bevelled edge at bottom right (see Fig.6).



This view shows the PC board before the 7-segment LED displays and the bargraph are plugged in.

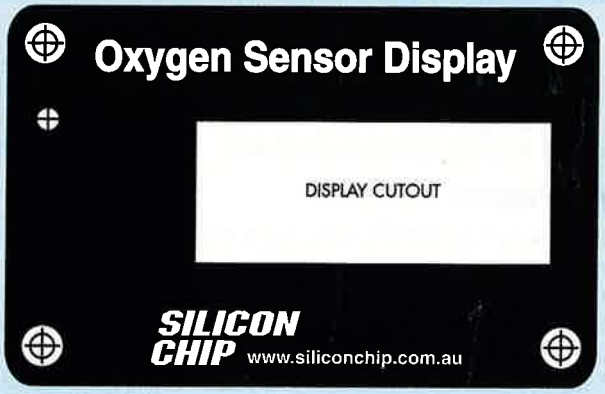


Fig.7: this full-size artwork can be used as a drilling template for the front panel.

programmed by providing the Mode, Select, Down & Up functions. These are connected respectively to the bases of transistors Q1-Q4, while the other ends are commoned and connected to the +5V rail via a 10kΩ resistor. This commoned end is also connected to IC1's AN2 input, which monitors the switches.

If switches S1-S4 are all open, IC1's AN2 input will be held at +5V via the 10kΩ pull-up resistor. However, if a switch is closed, AN2 is connected to the base of its corresponding transistor. As a result, the voltage on the AN2 input will drop to about 0.6V below the +5V rail (ie, to 4.4V) each time that particular transistor switches on.

In operation, the microcontroller periodically checks the voltage at its AN2 input. As a result, it can decide if a switch has been closed based on the AN2 voltage and then determine which switch it is by checking which transistor is currently switched on.

The optional external Alternative Display Switch is connected in parallel with switch S4. This switch can be a dashboard toggle switch so that, for example, either the air/fuel ratio or the lambda value can be shown. Alternatively, it can be a relay contact that automatically opens or closes depending on the fuel (eg, petrol or LPG).

Note that this switch is not required if the display only needs to show one set of values.

Input signal

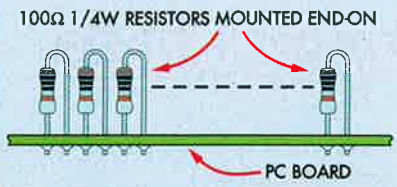
The signal from the sensor is fed to the AN4 pin of IC1. IC1 converts this input voltage into a 10-bit digital value

Table 2: Capacitor Codes

Value	µF Code	IEC Code	EIA Code
470nF	0.47µF	470n	474
100nF	0.1µF	100n	104
10nF	0.01µF	10n	103

Table 1: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	6	2.2kΩ	red red red brown	red red black brown brown
❑	1	10kΩ	brown black orange brown	brown black black red brown
❑	1	22kΩ	red red orange brown	red red black red brown
❑	8	100Ω	brown black brown brown	brown black black black brown



ALTERNATIVE TO USING RESISTOR ARRAYS

Fig.8: separate 100Ω resistors can be used instead of the two resistor arrays. Mount them as shown here.

which is then processed and the resulting calculation fed to the display.

A 2.2kΩ current-limiting resistor and internal clamping diodes inside IC1 protect the AN4 input should the input voltage go above the +5V supply or below the 0V rail. The associated 10nF capacitor filters any voltage spikes at the input.

A feature of unit is that it switches off all the displays for a short period before measuring the input voltage. This minimises any voltage drops that could occur due to supply current in the ground wiring if the displays were lit and ensures accurate measurements.

Timing for IC1 comes from an internal oscillator running at 4MHz. This has an accuracy of about 2% which is close enough for this application, as the timing is not critical.

Power supply

Power is derived from the vehicle's fused ignition supply. This +12V rail is fed to a low-dropout LM2940CT-5 +5V regulator. These regulators are designed for automotive applications and are protected against line transients and reverse supply voltage (if the supply is reversed, the output remains at 0V and no damage occurs).

A 470nF capacitor decouples the supply for the regulator input, while a 220µF capacitor filters the +5V output. This output capacitor supplies the transient current required for the displays and also prevents the regulator from becoming unstable.

In addition, the supply rail to IC1 is decoupled using a 100nF capacitor at pin 14. The 2.2kΩ resistor between IC1's MCLR-bar input (pin 4) and the +5V rail provides the power-on reset signal for IC1.

Construction

This unit is easy to assemble, with all parts installed on a double-sided PC

How The Micro Calculates The Values

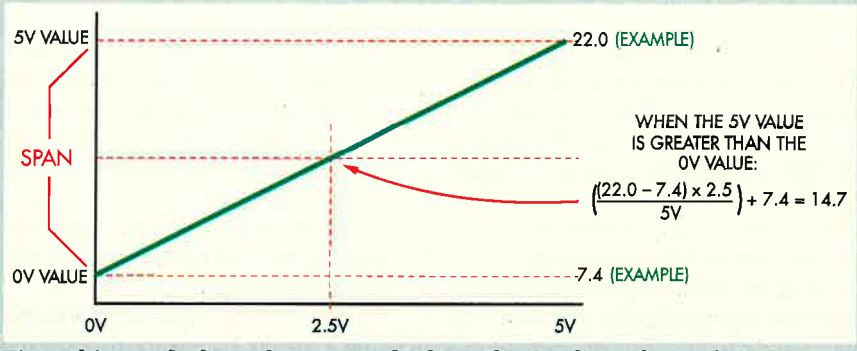


Fig.9: this graph shows how IC1 calculates the display values when the 5V endpoint value is greater than the 0V endpoint value. This example uses 7.4 and 22.0 for the 0V and 5V endpoint values respectively, giving a 2.5V sensor output value of 14.7 (ie, stoichiometric for unleaded petrol).

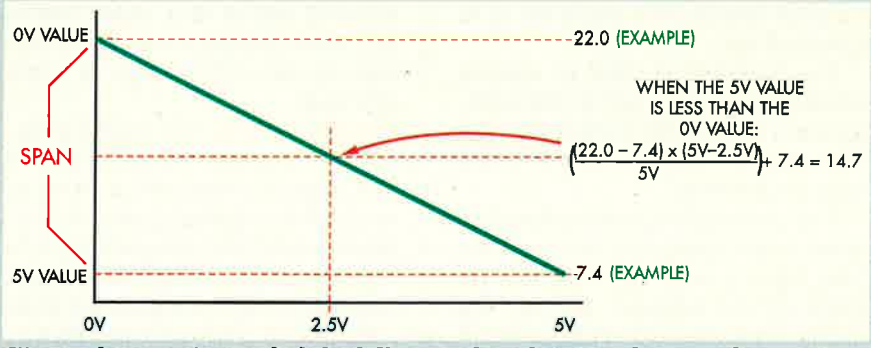


Fig.10: the equation is slightly different when the 0V endpoint value is greater than the 5V endpoint value. In this example, 22.0 has been used for the low endpoint value, while 7.4 has been used for the high endpoint value.

To set the values for the display, you only need to set the endpoint values at 0V and at 5V. The internal microcontroller then processes the input signal and calculates the correct vales for display.

For example, if the 0V endpoint value is 7.4 and the 5V endpoint value is 22.0, a 2.5V input will give a display reading of 14.7 for the air/fuel ratio. This is calculated by first subtracting the low endpoint value from the high endpoint value to get the span value (in this case, 22 - 7.4 = 14.6). This span value is then multiplied by the input voltage, divided by the 5V range and finally added to the low endpoint value (7.4 in our example). Fig.9 shows this in graphical form.

If the unit is set up so that the 0V endpoint value is higher in value than the 5V endpoint value, then the calculation is different (see Fig.10). In this case, the 5V endpoint value is subtracted from the 0V endpoint value to get the span value. This value is then multiplied by the difference between the input voltage and 5V, after which the result is divided by 5V and added to the 5V endpoint value. Fig.10 shows the equation for endpoint values of 22 and 7.4.

Note that in both cases, the 5V value assumes that the reference voltage used in the Oxygen Sensor Display is exactly 5V. However, the reference voltage from the regulator that's used could be anywhere from 4.85-5.15V so there is an adjustment to compensate for this.

If the reference voltage is below 5V, then the Oxygen Sensor Display will not show readings for input voltages that are higher than this reference. Conversely, if the reference is above 5V, then the unit will show readings for input voltages only up to the +5V. By compensating for this reference voltage, the correct value will be shown on the display.

In practice, the regulator used for the reference is trimmed during manufacture and its output will probably be very close to +5V.

Changing The Wideband Display Settings

THE FOUR PUSHBUTTON switches inside the case are for Mode (S1), Select (S2), Down (S3) & Up (S4).

Pressing the Mode switch initiates the **Settings** mode. Pressing it again then returns the display to the normal **Run** mode so that it shows the values in response to the input voltage.

Once in the **Settings** mode, you can alter the way the display operates. You can set how the dimming works, set the regulator voltage, alter the "A" or "B" values selection and alter the 0V & 5V endpoint values for each selection. In addition, you can change the bargraph display from dot to bar or to a centred bar.

The bargraph is used to indicate which setting is selected. In this mode, the lower LED (LED8) is always lit – see Fig.11 (note: LED8 is never lit in the normal run mode).

The remaining LEDs on the bargraph show which setting has been selected (see Fig.11). Note that there are 10-LEDs on the bargraph but only the middle eight (designated LEDs1-8) are used. **You cycle through the settings by pressing the Select switch (S2).**

Minimum Display Brightness: when LED7 is lit, the setting is for the minimum display brightness that occurs when the LDR is in complete darkness. This value is initially set at "14", as shown on the display.

When adjusting this value, it's necessary to cover the LDR so that it does not receive any ambient light either from below or above its surface. A black film canister is ideal for this and the value is adjusted using the Up & Down switches to set the desired minimum brightness.

The absolute minimum brightness is reached at 0 but typical settings would range from 10-30.

Dimming Threshold: pressing the Settings switch again brings up the Dimming Threshold setting, with LED6 lit. This is initially set at 200 and determines the ambient light level below which dimming begins. Increasing the value means that dimming begins at a higher ambient light level, while decreasing the value sets the dimming to begin at a lower light level.

Regulator Voltage: the next setting is for the Regulator Voltage (LED5 lit). This value is initially set at 5.00V and is normally adjusted (using the Up & Down switches) to agree with the actual regulator output voltage, as measured between its OUT and GND terminals.

A Or B Display: LED4 indicates the A or B Display selection. Here, you can select between the "A" and "B" display values. If "A" is selected, then the normal Run mode will show the "A values and the "B" value can be shown by pressing S4 (Up) or by using the external alternative display switch.

Alternatively, if the "B" values are selected, the display will show these in Run mode and the "A" values will be shown if S4 is press (or the external switch is toggled).

Display Format: the Display Format is next in the sequence (LED3 lit). In this case, the digital display will show A.AA, AA.A or AAA for the "A" selection. You can select the decimal point position using the Up or Down switches. Similarly, if the "B" values have been selected, the display will show b.bb, bb.b or bbb.

0V Display Value: pressing S1 again to light LED2 selects the 0V Display Value. This is the value that's displayed in Run mode when the input is at 0V and it can be set to any value from 0-999. Note that this value will be for the "A" display if this was previously selected in the "A Or B Display" option. Alternatively, this value will be for the "B" display if this was previously selected in the display option.

Note that where the "A" and "B" displays both need to be set, it will be necessary to temporarily change the display option from "A" to "B" or from "B" to "A" and also set the required Display Format before adjusting the endpoint value to suit the alternate display.

5V Display Value: this setting is indicated when LED1 is lit. Again, you can set this to any value from 0-999 and the same comments as above apply to setting values for both "A" & "B" displays.

It's important to note here that the 0V and 5V values must match the output from the wideband controller. This means that if you set the wideband

board with plated-through holes. This board is coded 05311081 (80 x 50mm) and is housed in a small plastic case measuring 83 x 54 x 31mm.

Begin by checking the board for any defects and by checking the hole sizes for the major parts. Check also that the PC board is cut and shaped to size so that it clips into the integral side slots in the case.

Fig.6 shows the parts layout. Install the resistors first, taking care to place each in its correct position. Table 1 shows the colour code values but you should also use a digital multimeter to check each resistor before installing it. Note that the 100Ω resistors are in single in-line (SIL) resistor arrays. However, you can also use standard 0.25W resistors here and these can be installed by mounting them end-on as shown in Fig.8.

Next, install the PC stakes. These are installed from the underside of the PC board at the three external wiring positions (the external wiring connects to the rear of the board).

Transistors Q1-Q4 can go in next and these must be installed so that their tops are no higher than 12mm above the PC board. Follow them with the four switches (S1-S4). These switches can only go in with the correct orientation so if the holes don't line up, simply rotate them by 90°

REG1 is next on the list. This device mounts horizontally on the PC board, with its leads cranked down through 90° so that they pass through their corresponding holes. Secure its tab to the board using an M3 x 6mm screw and nut before soldering its leads.

Once it's in, install the capacitors. Note that 220µF electrolytic adjacent to REG1 is installed with its leads bent through 90°. Its body lies horizontally across the regulator's leads as shown in the photo.

Mounting the displays

The 7-segment LED displays and the 10-LED bargraph are raised up off the PC board using IC sockets.

The sockets for the 7-segment dis-

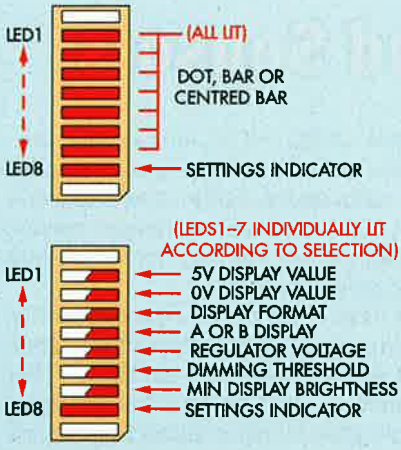


Fig.11: this diagram shows the bargraph setting indications for the default wideband operating mode.

controller to deliver air/fuel ratios over a range of 7.4 to 22.0, then the display should also be set to these values.

If you want to have the stoichiometric value in the middle of the scale (so that the bargraph display is centred), then the sum of the 0V endpoint value and the 5V endpoint value must be twice the stoichiometric value. So if the stoichiometric air/fuel ratio is 14.7, the 0V endpoint value and the 5V endpoint value must add up to 29.4 – eg, you could use 7.4 and 22.0 as the endpoints.

If you intend to display the lambda value, then the minimum and maximum values must add up to 2 (eg, 0.52 and 1.48 could be used but other values could be used instead).

Bargraph Display Option: the final selection brings up the Bargraph Display Option and in this case all eight LEDs are lit. Again, the options are selected using the Up & Down switches and are as follows: (1) dot (shown as **doT** on the display); (2) bar (shown as **bAr** on the display); and (3) centred bar (shown as **bCn**). Note that the "T" in the doT lettering has the lefthand side of its cross piece located over the "o".

The default setting for the bargraph display is to have the LEDs progressing upwards with increasing sensor output voltage. Conversely, if you want them to progress upwards with a falling sensor voltage, then it's just a matter of selecting the inverse, as follows.

To invert the "A" curve selection, press S2 at power up and the display will show the current selection. Initially, this will show "A.ni"(A not inverted) and this indicates that the A bargraph is not inverted. If S2 is now held pressed for four seconds, the display will change to show "A. i" (A inverted) to indicate that the bargraph operation is now inverted.

You simply release the switch when the required selection is displayed. Holding the switch down will cause the display to cycle between the inverted and non-inverted options.

Similarly, to set the "B" bargraph sense, S3 is pressed when power is applied. This will initially indicate "b.ni" (B bargraph not inverted) but can be changed to "b.i" (B bargraph inverted) by holding the switch down for four seconds.

It's easy to check the current selection by pressing S2 or S3 at power up. No changes will occur unless the switch is held for more than four seconds and the display changes to the next option.

plays are made using a 16-pin DIP socket and a 14-pin DIP socket. These are cut into strips of two 8-pin and two 7-pin SIL sockets using a small hacksaw. One 8-pin and one 7-pin strip is then installed along the top edge of the display positions, while the remaining 8-pin and 7-pin strips are installed along the bottom edge (ie, the sockets form two 15-pin strips).

Once these SIL strips are in, install a 20-pin DIP socket for the LED bargraph and an 18-pin DIP socket for IC1. Be sure to orientate the socket for IC1 with its notched end towards the top (ie, towards the 2.2kΩ resistor). Don't plug the displays or IC1 in yet, though

Finally, install the LDR (either way around) so that its top surface is 15mm above the top of the PC board.

Testing

Now for the smoke test but first go over the board carefully and check for incorrect component placement and for missed or shorted solder joints.

Next, with IC1 out of its socket, apply power to the +12V and GND terminals and check that 5V is present between pins 14 & 5 of IC1's socket. If this is correct, switch off and install IC1 and the displays. DISP1, DISP2 and DISP3 mount with the decimal points to bottom right, while DISP4 (the LED bargraph) mounts with its chamfered edge at bottom right (note:

PRIME
ELECTRONICS
Est. 1987
FLUKE
115 Compact DMM

True RMS
AC/DC Volts 600V
AC/DC Amps 10A
Resistance
Continuity
Frequency
Capacitance
Diode Test
Analog Bar Graph
Backlight
Min/Max/Avg
Display Hold
Auto/Manual Range
Holster
List Price $245.00
Our Price $199.00
179/EDA2 Combo Kit

Kit Contains
- Fluke 179 True RMS DMM
- TL224 SureGrip™ Silcone Test Lead Set
- TL910 Electronic Test Probe Set
- AC280 SureGrip™ Hook Clip Set
- TPAK Magnetic Hanger
- 80BK Intergrated DMM Temp Probe
- C35 Soft Meter Case

List Price $585.00
Our Price $499.00
Prices exclude GST
Call for a 2008 Fluke Catalogue
www.prime-electronics.com.au
Brisbane (07) 3252 7466
Sydney (02) 9704 9000

Using The Unit With Narrowband Sensors

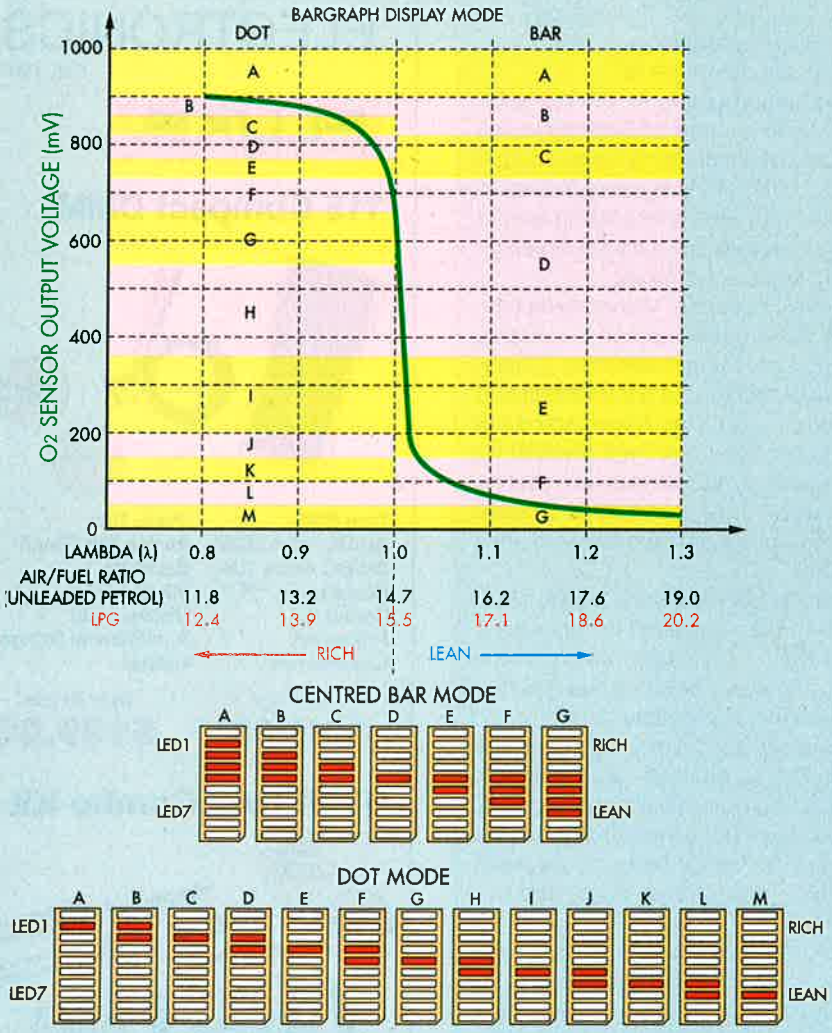


Fig.12: two bargraph options are available when the unit is set to operate in narrowband mode – either centred bar mode or a 13-step dot mode. The S-curve graph at top indicates which bargraph LEDs light in response to the various sensor output voltages.

WHEN USED WITH narrowband sensors, this unit will display air/fuel ratios that are calibrated to the S-curve output of a Bosch LSU11 narrowband oxygen sensor. Note, however, that this may not be accurate for other oxygen sensors.

In the case of the LSU11, it shows air/fuel ratios for unleaded petrol from 11.8 to 20.6, with the stoichiometric ratio set for 14.7. For air/fuel ratios below 11.8 the unit will show an "r" for rich, while for ratios above 20.6 the unit shows an "L" for lean.

For LPG, the range is from 12.6 to 21.4 with stoichiometric at 15.5. The unit displays an "r" (rich) for ratios below 12.6 and an "L" (lean) for ratios above 21.4.

For narrowband sensors, the bargraph options are as shown in Fig.12; ie, either a centred bar mode or a 13-level dot mode. These 13 different levels are achieved by lighting either one or two LEDs at a time.

For the bar mode, the centre LED is always lit and is the only LED that is lit at stoichiometric. The bar then progresses upwards from the middle LED for richer mixtures or below the middle LED for leaner mixtures.

Enabling the S-curve response

Enabling the narrowband S-curve response is easy: just press and hold the Mode switch as power is applied.

The display will then indicate the current display mode setting. This can be either the Linear (wideband) mode, the S-curve unleaded mode or the S-curve LPG mode. If the switch is released before four seconds the current display mode will not be altered. Conversely, if the switch is held down, the mode will cycle from one to the other at a nominal 4-second

the chamfer is quite subtle). IC1 goes in with its notched end towards the top.

When power is now reapplied you should be greeted with a display on the 7-segment digits and the bargraph. If not, check the orientation of IC1. If that's correct, check that transistors Q1-Q4 are BC327 PNP types.

Final assembly

As mentioned above, the PC board is designed to simply clip into the specified plastic case. A 48 x 18mm cut-out is made in the lid of the box for the displays and this cut-out is fitted with a red Perspex filter. In addition, a hole is drilled in the lid for the LDR, so that it is exposed to the ambient light.

A hole at the rear of the box allows the wiring to exit from the case.

The front-panel artwork shown in Fig.7 can be used as a template for cutting and drilling the holes. It can either be scanned or downloaded from the SILICON CHIP website and temporarily affixed to the lid using double-sided tape.

The cut-out for the LED displays can be made by drilling a series of holes inside the inside perimeter of the cut-out and then knocking out the centre piece. The cut-out is then carefully filed to a smooth finish.

The hole for the LDR should be drilled to 5mm, as should the exit hole in the back of the case. This exit hole should be positioned near the bottom edge of the case, so that it will directly line up with the PC stakes on the back of the board. Alternatively, you can drill the hole to 9.5mm and fit it with a 6mm ID rubber grommet.

Making the connections

We used twin-shielded wire for the power and input connections but

rate. You simply release the switch when the required display mode is shown.

It's also easy to tell which mode the unit is in. The display will show "Lin." for the linear mode (or wideband mode), while the two S-curve modes are shown as S.UL (S-curve unleaded) and S.LP (S-curve LPG).

Pressing the Mode switch after power-up has been applied initiates the **Settings** mode. As before, this allows you to alter the way the display operates. You can adjust how the dimming works, set the regulator voltage, alter the unleaded or LPG selection and change the bargraph display from dot mode to centred bar mode.

As in wideband mode, the bargraph LEDs are again used to indicate which setting has been selected. These settings are somewhat different for the narrowband S-curve modes but are altered in exactly the same manner.

Fig.13 shows the details. As before, only eight LEDs in the 10-LED bargraph are used and the lower LED (LED8) is always lit in the settings mode. The remaining LEDs on the bargraph show which setting has been selected and you can cycle through these settings by pressing switch S2.

Minimum Display Brightness : when LED7 lit, the setting is for the minimum display brightness that occurs when the LDR is in complete darkness. This value is initially set at "14", as shown on the display.

When adjusting this value, it's necessary to cover the LDR so that it does not receive any ambient light either from below or above its surface. A black film canister is ideal for this and the value is adjusted using the Up & Down switches to set the desired minimum brightness.

The absolute minimum brightness is reached at 0 but typical settings would range from 10-30.

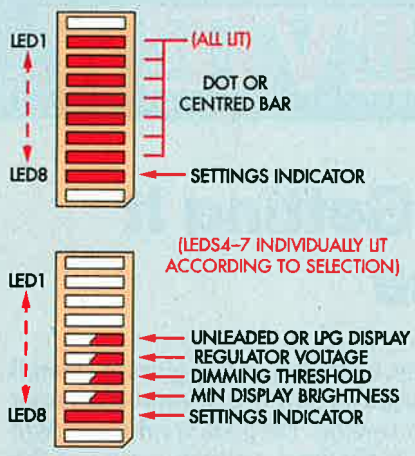


Fig.13: the setting indications for the narrowband mode. This mode is initiated by pressing and holding the Mode switch as power is applied.

Dimming Threshold: pressing the Settings switch again brings up the Dimming Threshold setting, with LED6 lit. This is initially set at 200 and determines the ambient light level below which dimming begins. Increasing the value means that dimming begins at a higher ambient light level, while decreasing the value sets the dimming to begin at a lower light level.

Regulator Voltage: the next setting is for the Regulator Voltage (LED5 lit). This value is initially set at 5.00V and is normally adjusted (using the Up & Down switches) to agree with the actual regulator output voltage, as measured between its OUT and GND terminals.

The regulator voltage adjustment can also be used to alter the unit's response to the oxygen sensor's output. For example, setting the regulator voltage to a value that's higher than the actual regulator voltage results in the unit displaying its full range of air/fuel values over a reduced voltage range. It effectively lowers the rich end of the S-curve, so that rich readings are indicated at lower oxygen sensor voltages.

Similarly, setting the regulator voltage value lower than the real regulator voltage increases the voltage range. This raises the rich end of the S-curve and rich readings are shown at higher oxygen sensor voltages.

Basically, this adjustment can be used to provide a more accurate air/fuel reading for the particular oxygen sensor used.

Unleaded Or LPG Display: LED4 indicates the Unleaded Or LPG Display setting. This can be toggled using either the Up or Down switch between S.UL (for unleaded petrol) or S.LP (for LPG). When normal mode is resumed, the display will then show the air/fuel ratio values for the selected fuel.

As before, the unit can be set up for both unleaded petrol and LPG and the display reading toggled using an external switch wired across S4. When this switch is open, the default air/fuel readings (as selected in the preceding paragraph) are displayed.

Bargraph Display Options: finally, S1 is pressed again to bring up the bargraph display options (all 8-LEDs are lit). Again, these are selected using the Up or Down switch and you can choose either the centred bar mode (shown as **bCn** on the display or the 13-step dot mode (shown as **doT**).

automotive wire could also be used. **Connect the +12V lead to the fusebox in the car so that the Oxygen Sensor display is powered only when the ignition is on (ie, be sure to connect to the fused side).** The ground connection should preferably connect to the same ground as the wideband controller.

For narrowband use, connect the ground to the same ground as the sensor. The input lead for the Oxygen Sensor Display is connected either to the 0-5V output from the wideband controller or (if you are saving money) to a narrowband sensor signal.

Fit a cable tie around the leads on the inside of the box, to prevent them being pulled out of the hole.

Setting up

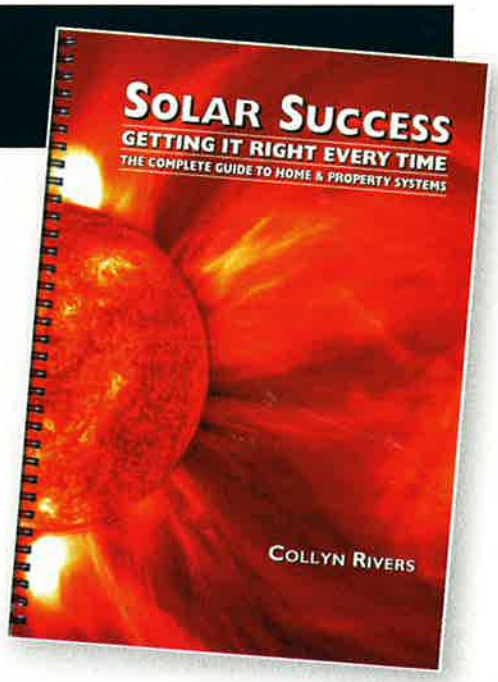
For use with a wideband controller, the unit is set up as described in the panel titled "Changing The Wideband Display Settings".

Note that commercial wideband controllers can have either fixed or adjustable endpoint values. The adjustable versions have their endpoints set by connecting them to a computer. **Note also that the endpoint values programmed into the display unit must match those of the wideband controller. This ensures that the unit is correctly calibrated and gives accurate air/fuel ratio readings.**

Switching between the "A" and "B" display values (eg, between air/fuel ratio and lambda values or between unleaded petrol and LPG air/fuel ratios) can be achieved by wiring an external switch (or NO relay contacts) in parallel with switch S4 (see Fig.6).

Note that the connections on the relay contacts or switch must be solely for this purpose. If you need to switch a fuel valve or anything else at the same time, use a double-pole relay or switch. **SC**

BOOK REVIEW



Solar Success: Getting It Right Every Time

Solar Success: Getting It Right Every Time, by Collyn Rivers. First edition, published June 2008 by Successful Solar Books, Broome, Australia. 112 pages, 210 x 296mm, spiral bound. ISBN 0 9578965 6 5. $47.50.

BILLED AS THE complete guide to home and property systems, this book looks at what you need to do in order to convert from conventional grid power to either a fully solar-powered system in a remote location or a grid-connected solar system. Either way, there is a large emphasis on improving the efficiency of your existing electrical appliances and the ways in which you use electrical energy.

In fact, even if you are not particularly committed to the idea of converting to solar power, it is well worthwhile reading this book in order to get a better approach to energy efficiency. Author Collyn Rivers is something of a crusader on this aspect and his insights will be most useful to everyone who will be confronted by ever-higher electricity tariffs in the next few years, particularly those associated with the introduction of smart power meters.

As Collyn points out, there is little point in investing a lot of money in a solar-powered system if your refrigerator or other key appliances are inefficient. You will be better off replacing these appliances with more efficient units. In this way, you will spend far less on the total solar installation and still be in front on total investment. Collyn also alludes to a new 10-point appliance Star Rating system which will be introduced from early 2009.

I should point out that this book will not show you how to do an actual solar installation. In Australia, that can only be done by licensed electricians and installers and that is particularly the case if you wish to claim for a solar rebate. Instead, the book gives an overall insight on how to best approach a solar conversion. The book is split into eight parts. Of these, perhaps parts 1, 2, 3 & 6 are the most important as they focus on the key issues.

In part 1, lighting is the first topic to be discussed. The various types of lights are covered, together with their luminous efficacies. Fridges and freezers are touched on briefly but there is an important section later in the book which shows how a refrigerator should be installed for best efficiency. Airconditioners are also discussed but unless you are prepared to invest in a large number of solar panels and a very expensive battery bank, they are really not practical.

Space heating also gets a mention but this is not a proposition with solar power. It is feasible with grid-connect systems but then only with heat pumps or geothermal transfer systems.

Washing machines and dryers are briefly discussed, with the observation that front-loaders are generally less-power hungry than top loaders and clothes dryers are generally a no-no for solar installations – better to dry the clothes in sun!

Other appliances briefly covered include microwave ovens (very power hungry but generally only used for short periods), power tools and TV sets. Large plasma TV sets are very power hungry and most solar home dwellers would probably not consider them.

One of the most important topics is that of "phantom loads". This is normally referred to as "standby power" and is a feature of most permanently connected appliances these days, even when they are nominally "off".

For any grid-connected home, standby power is not really a problem but it can quite easily add up to a lot of power for the convenience of having something turned on a by a remote control. However, in a solar-powered home, such phantom loads can cause the DC-AC inverter to run continuously rather than when an appliance is actually being used. This can mean that battery usage is much higher than it should be and it can mean that batteries can be substantially discharged over a period when no 240VAC power was actually required.

Another way of looking at it is that you would need to install a larger battery bank than would otherwise be required if no "phantom loads" existed. The only practical approach is to use appliances which do not have standby power or turn them off at the wall when they are not in use.

Part 2 is devoted to solar basics and it shows how solar panels are connected in series and parallel combinations, depending on the size of the installation. It also discusses panel performance, batteries and charging, and generators (for when the sun does not shine).

Part 3 is perhaps the most important as it talks about the energy audit you need to do before designing the system. Finally, Part 6 discusses actual examples such as a small cabin, a mid-sized cabin and larger systems away from grid power.

Inevitably, space does not permit much more detail about the book but it should be apparent that this is a very practical text. The book is now available from the SILICON CHIP bookshop. (L. D. S.)

How to add a wireless infrared port to the DSP Musicolour – or in fact virtually any microcontroller project.

Musicolour IrDA Accessory

By Mauro Grassi

Most PCs and laptops now offer an IrDA interface to enable communication without any physical connection. Now you can have the same facility for the DSP Musicolour – or for virtually any other microcontroller project.

In the June, July and August 2008 issues of SILICON CHIP we described the DSP Musicolour, an advanced light show based on the dsPIC30F4011 microcontroller from Microchip.

We mentioned that the firmware supports a high speed UART (Universal Asynchronous Receiver Transmitter).

The PC board below (which in fact can replace the September infrared remote control PC board) adds an IrDA (Infrared Data Association) compatible serial port for the DSP Musicolour.

This gives you all the features the original remote control offered but adds a huge amount of additional features via the serial port of your PC.

Although the firmware in the DSP Musicolour supports a high speed UART running at up to 1.84Mbps, this interface will run at the much slower baud rate of 9.6Kbps, which is the default baud rate of the DSP Musicolour.

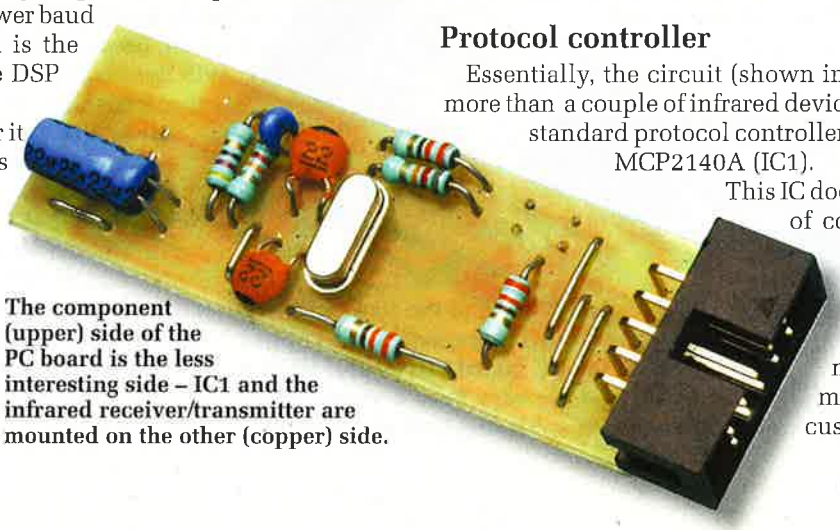
There is little need for it to be higher as 9.6Kbps should be fast enough for most applications (if you wish to use a higher baud rate, you could connect a wired serial port).

IrDA is ideal for adding a serial port to a mains-rated circuit as the UART is completely isolated. Since it is infrared, it is also very convenient. Operating distance is not great – the specification says around 1m (without any obstacles) – but we found it works over greater distances than that.

Although this circuit was designed specifically for the DSP Musicolour, it could be adapted so as to add an IrDA-compatible serial port to any microcontroller project. We give you a recommended circuit to do this.

Because it was designed specifically for the DSP Musicolour, it also includes an infrared remote control receiver, thus effectively superseding the small infrared remote control PC board published in the September 2008 issue of SILICON CHIP.

However, that project is still perfectly valid if you just want to control the DSP Musicolour using a remote control.



The component (upper) side of the PC board is the less interesting side – IC1 and the infrared receiver/transmitter are mounted on the other (copper) side.

Protocol controller

Essentially, the circuit (shown in Fig.1 overleaf) is little more than a couple of infrared devices and a dedicated IrDA standard protocol controller IC from Microchip, the MCP2140A (IC1).

This IC does most of the hard work of communicating and setting up the connection with your PC.

We suspect that internally, this IC is nothing more than a PIC microcontroller with a custom program.

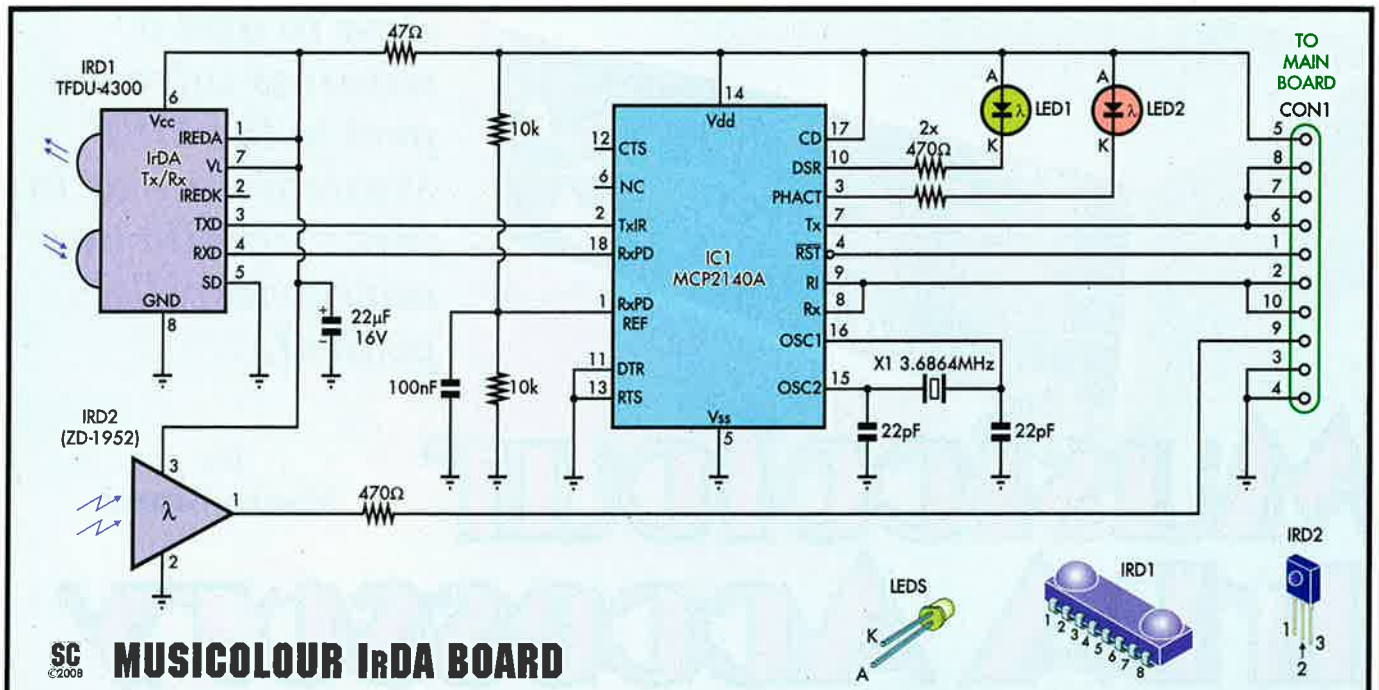


Fig.1: the circuit is very simple, consisting of little more than a couple of infrared devices (IRD1 & 2) plus a dedicated IrDA standard protocol controller (IC1). CON1 connects to CON3 on the back edge of the DSP Musicolour PC board.

In fact, Microchip provide the IrDA protocol stack source code as a free download on their website.

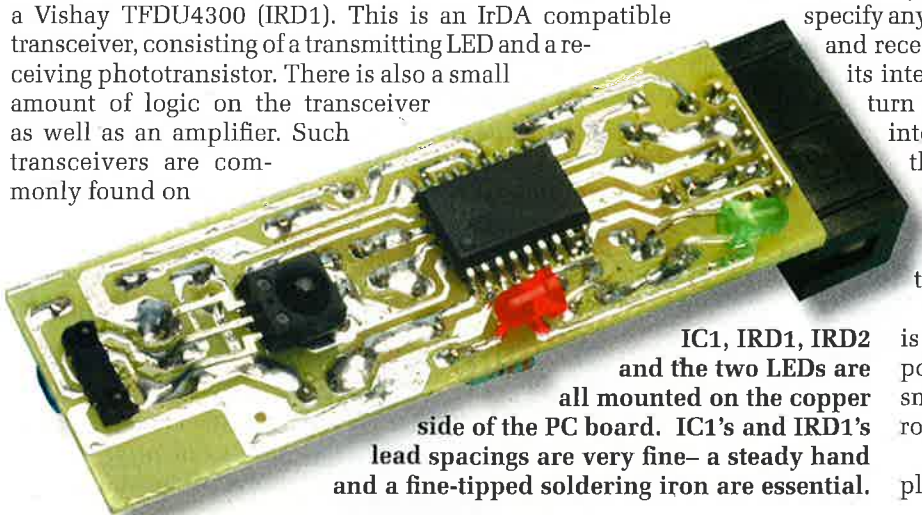
Don't use the MCP2140!

Note that the MCP2140 was the original IC in this series but the MCP2140A is operationally different. The MCP2140A will not work as a replacement for the MCP2140 and vice versa. That's because the MCP2140A works with a 3.6864MHz crystal, whereas the MCP2140 works with a 7.3728MHz crystal. The two ICs require different input signals into pin 18, too.

Speaking of the 3.6864MHz crystal, it connects to the two internal oscillator pins of IC1 (OSC1 and OSC2) to provide the system clock. A pair of 22pF ceramic capacitors provide the correct loading for the crystal.

Infrared transceiver IRD1: the Vishay TFDU4300

To receive and transmit data over an IrDA link, we use a Vishay TFDU4300 (IRD1). This is an IrDA compatible transceiver, consisting of a transmitting LED and a receiving phototransistor. There is also a small amount of logic on the transceiver as well as an amplifier. Such transceivers are commonly found on laptop motherboards and PDAs. In fact, we used a similar transceiver in a previous design to add an IrDA port to your desktop PC (SILICON CHIP December 2001).



IC1, IRD1, IRD2 and the two LEDs are all mounted on the copper side of the PC board. IC1's and IRD1's lead spacings are very fine– a steady hand and a fine-tipped soldering iron are essential.

The operation of IRD1 is simple enough. Pin 1 (IREDA) is the anode of the internal infrared LED while pin 2 (IREDK) is the cathode. In normal operation, you connect IREDA to the supply rail (in this case around +5V) and leave IREDK disconnected. IREDK can be used externally to turn on the LED but in our case, the LED is switched on and off by internal logic.

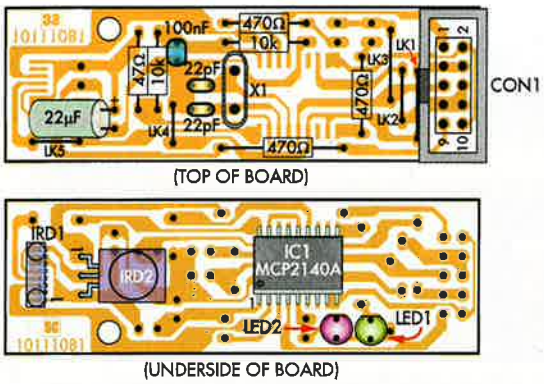
Note that a current limiting resistor is not needed to IREDA as the internal circuit of IRD1 limits the current through the LED.

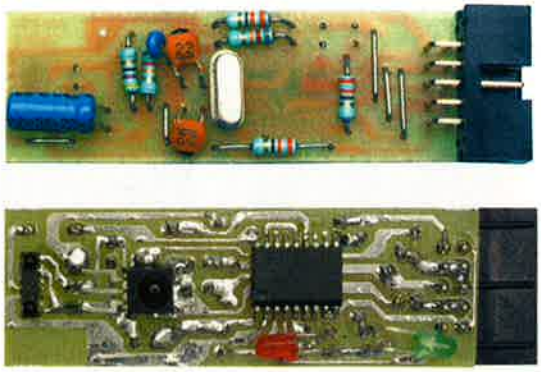
Pins 3 and 4 of IRD1 are the transmit and receive lines respectively, encoded as RZI (Return to Zero Inverted) signals. The MCP2140A translates the NRZ (Non Return to Zero) encoding at its Tx and Rx pins to RZI signals at its TxIR and RxPD pins.

The IrDA is only half duplex because the standard does not specify any optical isolation between the transmitter and receiver. When IRD1 is transmitting through its internal infrared LED, the receiver will also turn on, because the phototransistor is biased into conduction by the infrared light from the transmitting LED. The MCP2140A drives the transceiver in half-duplex mode while presenting a full duplex interface to the host device (in this case, the dsPIC30F4011).

Pin 5 is the shutdown pin (SD), which is active high. When high, IRD1 goes into power conservation mode, drawing a very small current (typically down to 0.1µA at room temperature).

This is useful for battery powered applications but in our case, where we are





Figs.2a and 2b (left) show both sides of the PC board, with matching photos at right. Note that the 22µF capacitor needs to be installed flat, otherwise there would not be room for the PC board inside the DSP Musicolour case. These diagrams/pics are reproduced 1:1.

supplying power from the Musicolour supply, we ignore this connection and tie it permanently to ground.

Pin 6 is the supply voltage to IRD1 and pin 7 (V_L) selects the voltage level for the logic. This makes IRD1 customisable to different logic families with different threshold voltages. In our case, we connect it to the +5V supply rail. Finally, pin 8 is the ground connection for IRD1.

The 22µF electrolytic capacitor is used to bypass the supply rail to IRD1 through the 47Ω resistor. The capacitor and resistor isolate the transceiver from a possibly noisy supply rail, which can interfere with IRD1's sensitive internal receiving circuit.

The two 10kΩ resistors form a voltage divider and are used to split the supply voltage and set the threshold for the receiving logic level for IC1.

Any level above the voltage at pin 1 of IC1 (RxPD Ref) is interpreted as a high level. Conversely, any level below that is interpreted as a low level. This pin therefore sits at around 2.5V. A 100nF capacitor is used to bypass this rail.

The DSR (Data Set Ready) output of IC1 will go low (thus turning on LED1 (green)) when a valid connection has been established with the host. It is locally emulated by IC1 and can indicate to a microcontroller that IC1 is ready to receive and transmit data. Thus LED1 indicates that the MCP2140A has established a valid connection with your PC.

The PHACT (physical activity) output of IC1 (pin 3) is open collector and will sink current (thus turning on LED2 (red)) when there is a period of inactivity from the receiver for around 10 seconds. This pin can be pulled up to the supply rail using a resistor (1kΩ will do) and can then control pin 5 (SD) of IRD1 through an inverter, if desired.

In this configuration, it puts the transceiver in low power mode after a 10-second timeout. In our case, we use the output to control LED2 and to indicate to the user that no signal has been detected for at least 10 seconds. This can be useful for troubleshooting.

Pin 7 (Tx) and pin 8 (Rx) are the UART transmit and receive lines while RI (Ring Indicator), CD (Carrier Detect), DTR (Data Terminal Ready), RTS (Request to Send) are all part of the serial port handshaking signals. Normally, IC1 will transmit and receive the state of these lines to the PC, emulating a full serial port.

In our case, we are really only using the raw 3-wire serial port so we ignore these handshaking lines. We tie the DTR line to ground, ignore the CTS output of IC1 and connect RI to Rx. This is done simply to make the layout of the PC board more compact. In any case, we only care about the Tx and Rx lines and these connect to the corresponding lines on the dsPIC30F4011 through CON1.

However, the RTS input of IC1 (pin13) is used locally to indicate that the MCP2140A is ready to receive data. We therefore tie this line permanently to ground.

Finally, pin 4 (/RST) is an active low reset pin and is tied directly to pin 1 of CON1 (which connects to CON3 of the DSP Musicolour main board and is the reset line of the dsPIC30F4011 microcontroller).

The other infrared module (IRD2) is used for the RC5 remote control decoding and is really a separate circuit on the same PC board.

Pins 3 and 2 provide the supply for IRD2 and pin 1 is the decoded remote control data, very similar to the remote control add-on board we described in the September 2008 issue of SILICON CHIP.

A 470Ω resistor is used between the output of IRD2 and pin 9 of CON1 because pin 9 connects to the RF6 pin of the dsPIC30F4011 on the DSP Musicolour main board. Because this pin can sometimes function as an output, the resistor is used to limit the current into the data output pin of IRD2.

Construction

This is a simple PC board that should take a matter of minutes to build. Fig.2 shows the parts layout.

The Musicolour IrDA PC board is coded 10111081 and measures 61mm x 20mm. Inspect the board for any hairline cracks or unintended shorts before beginning the assembly.

If you are satisfied that the PC board is good, begin by installing the six wire links.

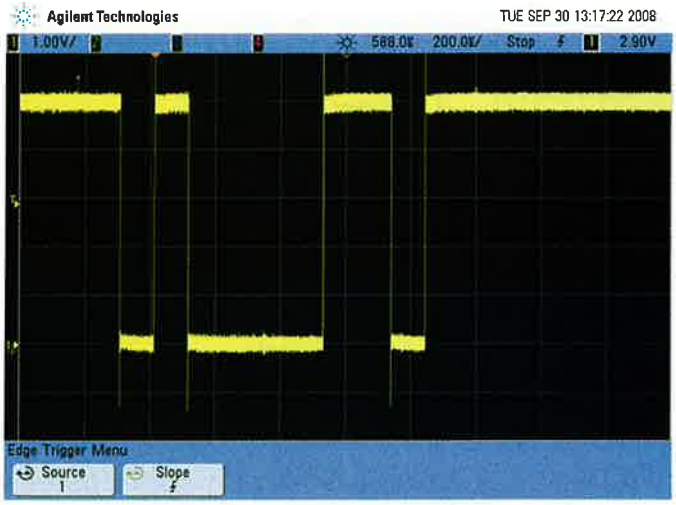
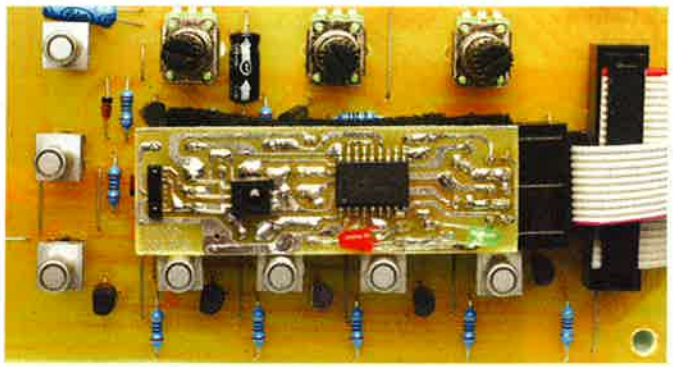
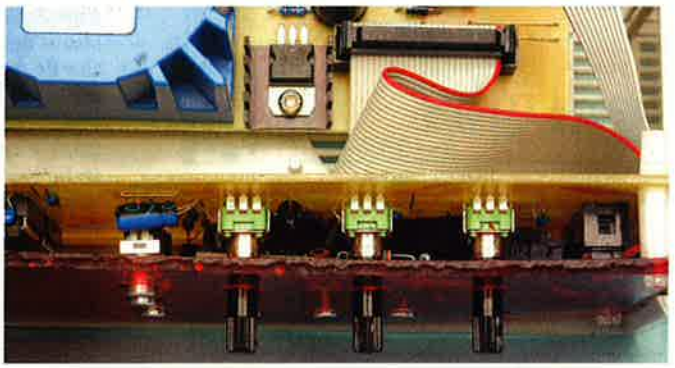


Fig.3: oscilloscope screen grab showing the NRZ encoding for a typical RS232 signal at the PHY.



The IrdA board is sandwiched between the DSP Musicolour display board and the red acrylic front panel, with a piece of non-conductive foam holding it in place.



Here's what it looks like from above – in this photo you can mostly see the black foam. The connecting cable curves around the edge of the display PC board.

Once that is done, install the six resistors. The resistor colour codes are shown in the colour code table but you can check them with a DMM too.

After soldering these, you can solder in the capacitors. Start with the two ceramic capacitors near the crystal, then install the small monolithic. Finally, install the larger electrolytic capacitor, which must be oriented correctly, as shown on the component overlay.

Solder in the crystal so that it sits flush with the PC board. The top layer components except the IDC header should now look like that in the PC board top layer photograph.

Now turn the board over to the bottom layer (where the tracks are). There are two SMD (surface mount devices) on the bottom layer, namely the MCP2140A (IC1) and the TFDU4300 (IRD1).

Soldering the SMD ICs

You will need a magnifying lamp (or glass with good light), a fine-tipped soldering iron and a steady hand. You should start with IC1 because it is of relatively large pitch. Place it on its pads, making sure it is oriented correctly.

Once it is in place, solder pin 18 by applying heat and a little solder. Once that is done, solder pins 8 and 9 (diagonally opposite pin 18).

The IC should then be properly anchored and not able to move. Proceed to solder the remaining 15 pins. The result should be as shown in the photograph.

Now comes the hardest part! You need to solder in the IrDA transceiver, which has a finer pitch. Place it on its pads and hold it in place while applying heat and a very small amount of solder to pin 1.

You then solder in pin 8 in the same way, before soldering in the remaining pins. Apply heat and solder each pin quickly before moving on to the next pin. Do not apply too much heat as that can damage the plastic case as well as the integrated circuit itself.

Don't worry if you get solder bridges between adjacent pins, as these can be removed by using solder wick. Carefully inspect your soldering, preferably using an illuminated magnifier or loupe and if you find any bridges, remove them. Refer to the article on soldering SMD components on page 22 of the March 2008 SILICON CHIP for more details.

Now solder in the infrared receiver module IRD2. You should aim for around 7mm of lead, which will allow you to bend the module down 90° once it has been soldered, so that it sits flush with the PC board (as we have shown in the close-up photo).

The two LEDs are similarly bent down 90° after soldering. Make sure that they are oriented correctly.

The last thing to do is to solder in the 10-way IDC right-angled header. Again, check for solder bridges once it is soldered in place.

You can then connect the Musicolour IrDA board to the DSP Musicolour's main board using the 10-way ribbon

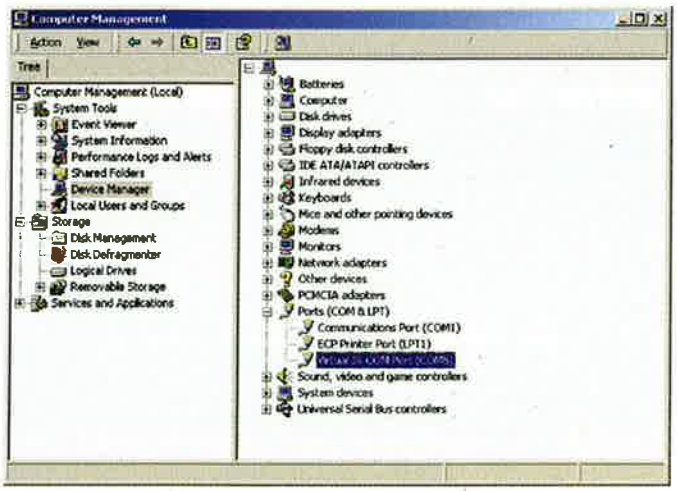


Fig.4: a screen shot from Windows' device manager showing the ircomm2k driver installed and recognised correctly.

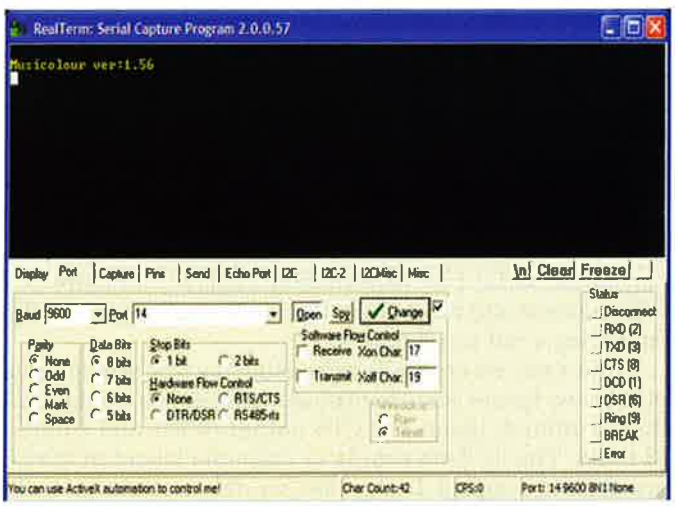
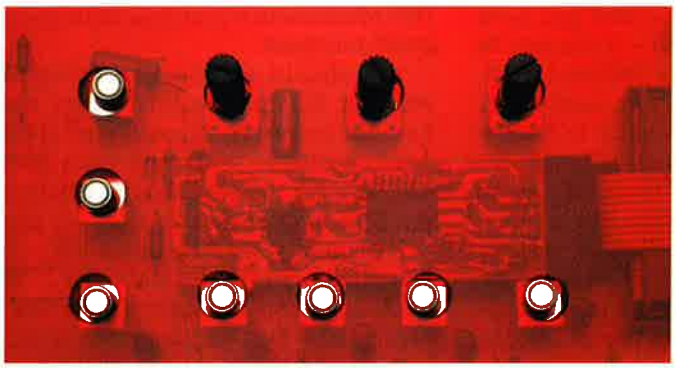
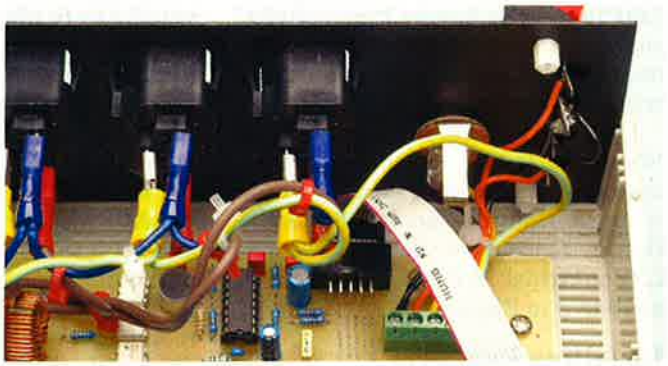

RealTerm: Serial Capture Program 2.0.0.57
Musicolour ver:1.56
Display Port Capture Pins Send Echo Port I2C I2C-2 I2CMisc Misc
Clear Freeze
Baud 9600 Port 14 Open Spy Change
Parity None Odd Even Mark Space
Data Bits 8 bits 7 bits 6 bits 5 bits
Stop Bits 1 bit 2 bits
Hardware Flow Control None RTS/CTS DTR/DSR RS485
Software Flow Control Receive Xon Char 17 Transmit Xoff Char 19
Status Disconnect RXD (2) TXD (3) CTS (8) DCD (1) DSR (6) Ring (9) BREAK Error
You can use ActiveX automation to control me!
Char Count:42 CPS:0 Port: 14 9600 8N1 None

Fig.5: screen shot showing Realterm in action communicating with the DSP Musicolour.



From the front, without any labelling on the acrylic sheet you can easily see the three main components (the two IRDs and the controller chip)



The opposite end of the ribbon cable connects to the same socket on the rear of the PC board as used in the September 2008 article.

cable. CON1 connects to CON3 on the DSP Musicolour main board, in exactly the same way as described in the article in the September 2008 issue (pages 72-75).

We explained how to make a 26-way ribbon cable connecting the main board to the display board in the July 2008 issue (page 26 under Ribbon Cable Assembly). The 10-way ribbon cable used to connect the remote control board is made in the same way.

Your IrDA Board is now complete and ready for mounting in the DSP Musicolour front panel.

Disconnect power!

The first thing to do is disconnect power from the DSP Musicolour – pull the IEC plug out of its socket to make absolutely sure. Then, and only then, open the case.

Do not proceed unless you are absolutely sure you know what you are doing. Don't be tempted to connect power while the case is open – it is too dangerous.

Where it sits

The IrDA PC board fits between the red acrylic front panel and the display PC board. A piece of foam holds it in place and also insulates it from the components on the display board.

This is not an ideal mounting solution . . . but it is just about the only one! Because this board is an add-on, it was not catered for in the original DSP Musicolour design. But we think it's a practical addition and we've made the only mounting decision possible.

Again, we have shown a close-up photo to show how it goes in. You can then close the case again by screwing it shut.

Using the IrDA board with the DSP Musicolour

This add-on board gives the DSP Musicolour a wireless serial port you can use to communicate with a PC. It also allows the DSP Musicolour to be operated using an RC5 remote control, in the same manner as explained in the September 2008 of SILICON CHIP (pages 72-75). You can define the remote control codes as explained in that article.

Software for Windows: the IRCOMM2K driver

Before communicating with the IrDA board, you will need to install a software driver implementing the IrCOMM protocol on Windows 2000 and XP.

It is a free download from **www.ircomm2k.de/English/index.html**, or via a link on the SILICON CHIP website (**www.siliconchip.com.au**).

Follow the installation instructions. Note that your PC must have an IrDA port installed. This is commonly found on laptop computers and PDAs (but not all laptops will have an infrared port).

Most modern desktop motherboards also have supporting circuitry for it but will probably lack the optical transceiver. Refer to December 2001 SILICON CHIP if you want to add an IrDA port to your desktop PC.

Using the IrDA serial port

Once you download the zipped **ircomm2k** driver, extract the files and run setup.exe. The install program will prompt you for the serial port number to install the virtual IR port. Choose a port number (say COM5) that will not interfere with any other (physical) serial ports implemented on your PC.

You should then disable the "Wireless Image Transfer" in Windows. Go to Control Panel > Wireless Link and in the image transfer tab, unclick the box selecting "Use Wireless

Parts List – Musicolour IrDA Accessory

1 PC board, coded 10111081, 63mm x 21mm
1 3.6864MHz PC board mounting crystal (X1)
1 10-way PC board mounting IDC male connector
1 10-way ribbon cable, approx. 250mm long fitted with female line sockets

Semiconductors
1 MCP2140A
1 TFDU-4300 infrared transmit/receive module
1 Infrared receiver (eg Jaycar ZD-1952)
1 3mm green LED (LED1)
1 3mm red LED (LED2)

Capacitors
1 22µF 16V electrolytic
1 100nF ceramic
2 22pF ceramic

Resistors (0.25W, 1%)
1 47Ω 3 470Ω 2 10kΩ

Link to transfer images from a digital camera". This needs to be disabled because the Windows service interferes with the **ircomm2k** driver.

Once that is done, you should reboot Windows. If the driver is installed correctly, you should be able to see it under Control Panel > System > Device Manager > Ports COM and LPT > Virtual IR COM Port (COM5), as shown in Fig.4.

Installing Realterm

The final thing to do is to use a terminal program to communicate with the Musicolour IrDA board. You can use Windows' hyperterminal if you wish, available under Start > Accessories > Communications > Hyperterminal.

Another good program to use is the freely available realterm. Download it from http://realterm.sourceforge.net/

Once that is installed, you can establish a link with the Musicolour IrDA board using COM5 (or whatever number for the virtual IR port you chose in the installation step above).

You should set the encoding to 8 bits, 1 stop bit, no parity, 9.6Kbps. As soon as you open Realterm and start typing characters, the green LED (LED1) on the IrDA board will light, indicating that a valid connection has been established.

Remember that you need to position your PC or laptop so that its infrared transceiver is in the line of sight of IRD1 and within 1m or so.

The characters you type will then be sent via the infrared link to the Musicolour IrDA board and onto the UART on the main board of the Musicolour (ie, on the dsPIC30F4011 microcontroller). A typical screen shot is shown in Fig.5.

In the DSP Musicolour menu system, you can go to the CONSOLE > COM submenu. There the DSP Musicolour will display the received characters from the serial port and echo back the same character. You should do this to test that the IrDA board is working correctly.

As you type your characters in Realterm, you should see them appear on the dot matrix display of the DSP Musicolour.

How to upgrade the firmware of the DSP Musicolour

If there are some aspects of the DSP Musicolour's firmware which you'd like to change – and you have the knowlege to do so – it can can be upgraded using this infrared port. Using Realterm, you can send a hex file to the DSP Musicolour to force it to reconfigure its flash memory using its RTSP server. To do this, go to the ADVANCED > Write Mode menu and set it to 6 (thus allowing writing of the flash memory). Then go to the ADVANCED > Software Upgrade submenu. Once you enter that mode, the dot matrix display will go blank.

The DSP Musicolour will send a string to your Realterm window through the infrared link. You can then use realterm to send a hex file to the DSP Musicolour which will reprogram itself and reset.

You should set the line delay to 40ms or higher. You then select the hex file you want to send and click send. Realterm will send each line and wait for the set line delay before sending another line.

If manually sending hex file lines, you must send the :00000001FF (end of file) line to indicate to the DSP Musicolour that programming is finished. Once the EOF (end of file) line is received by the RTSP server, the DSP Musicolour will reboot after 10 seconds and the new firmware version will be operational. SC

How to modify the PC board to add an infrared serial port to a microcontroller project

As we mentioned before, this PC board was designed to interface with the DSP Musicolour main board. But it can easily be modified to add a serial port to your next microcontroller project.

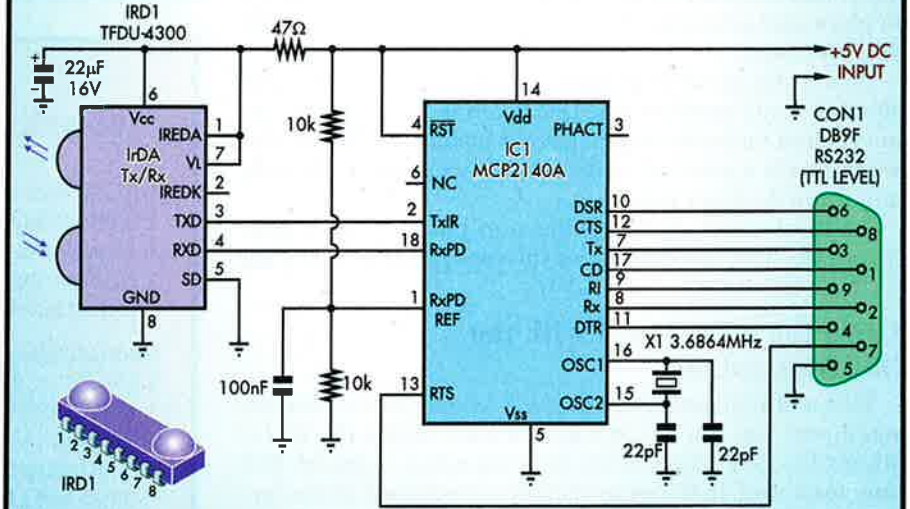
The modified circuit diagram below shows a typical application. The levels at CON1 are only TTL levels, adequate for interfacing directly to most microcontrollers implementing a UART.

Note that if you wish to interface the modified board directly to a PC and need true RS232 voltage levels, you will need to add a MAX232 or similar IC to translate the TTL levels at CON1 to true RS232 levels (this is not shown in the circuit diagram).

The host (ie, the microcontroller) should only send data to the MCP2140A when CTS (Clear To Send) is low.

On the other hand, the host should drive DTR (Data Terminal Ready) low when it is ready to receive data from the MCP2140A.

The host can then send and receive data from the MCP2140A through the Tx and Rx pins (encoded as NRZ) ultimately to the connected IrDA-enabled PC or PDA (confusingly this is also a host, ie, the IrDA host!).



SC ©2008 **MODIFIED IrDA CIRCUIT**

Use this modified circuit to add a wireless serial port to virtually any microcontroller project. Unlike the circuit used specifically to interface to the DSP Musicolour main board, this circuit emulates the full serial port rather than just the Rx and Tx signals. This can be used for handshaking between the microcontroller and IC1.

SILICON CHIP

www.siliconchip.com.au

Order Form/Tax Invoice

Silicon Chip Publications Pty Ltd
ABN 49 003 205 490

YOUR DETAILS

Your Name_____
(PLEASE PRINT)

Organisation (if applicable)_____

Address_____

_____

Postcode_____ **Daytime Phone No. (** **)**_____

Email address (if applicable)_____

Method of Payment:

❑ Cheque/Money Order ❑ Visa Card ❑ Master Card

Card No. | | | | | | | | | | | | | | | |

Card expiry date: | | | |

Signature_____

PRICE GUIDE: SUBSCRIPTIONS

(Note: all subscription prices include P&P). (Aust. prices include GST)

Please state month to start.

Australia: 1 yr	$A89.50	2 yrs	$A172
1 yr + binder	$A105	2 yrs + 2 binders	$A203
NZ (air): 1 yr	$A96	2 yrs	$A190
Overseas (air): 1 yr	$A135	2 yrs	$A260

PRICE GUIDE: OTHER PRODUCTS

(all prices include GST on Aust. orders)

***SILICON CHIP BACK ISSUES in stock:** 10% discount for 10 or more issues or photocopies. Australia: $A9.50 ea (including p&p). Overseas: $A13 each (including p&p by air).

***ELECTRONICS AUSTRALIA:** project photocopies. Australia: $A9.50 each (including p&p). Overseas: $A13 each (including p&p by air).

***BINDERS:** BUY 5 or more and get them postage free. (Available in Aust. only): $A13.95 each plus $7 p&p per order.

***ELECTRONICS PROJECTS FOR CARS, VOL.2:** Aust. $A14.95; Overseas $A18.00. (Prices include p&p & GST where applicable).

***PERFORMANCE ELECTRONICS FOR CARS:** Aust. $A22.50; Overseas $A26.00. (Prices include p&p & GST where applicable).

SUBSCRIBERS QUALIFY FOR 10% DISCOUNT ON ALL SILICON CHIP PRODUCTS*

* except subscriptions/renewals

Qty	Item Description	Item Price	P&P if extra	Total Price
Total			$A	

BUY 10 OR MORE BACK ISSUES & GET A 10% DISCOUNT

***Subscribe to SILICON CHIP on-line at:* www.siliconchip.com.au**
Both printed and on-line versions available

TO PLACE YOUR ORDER

Phone (02) 9939 3295
9am-5pm Mon-Fri
Please have your credit card details ready

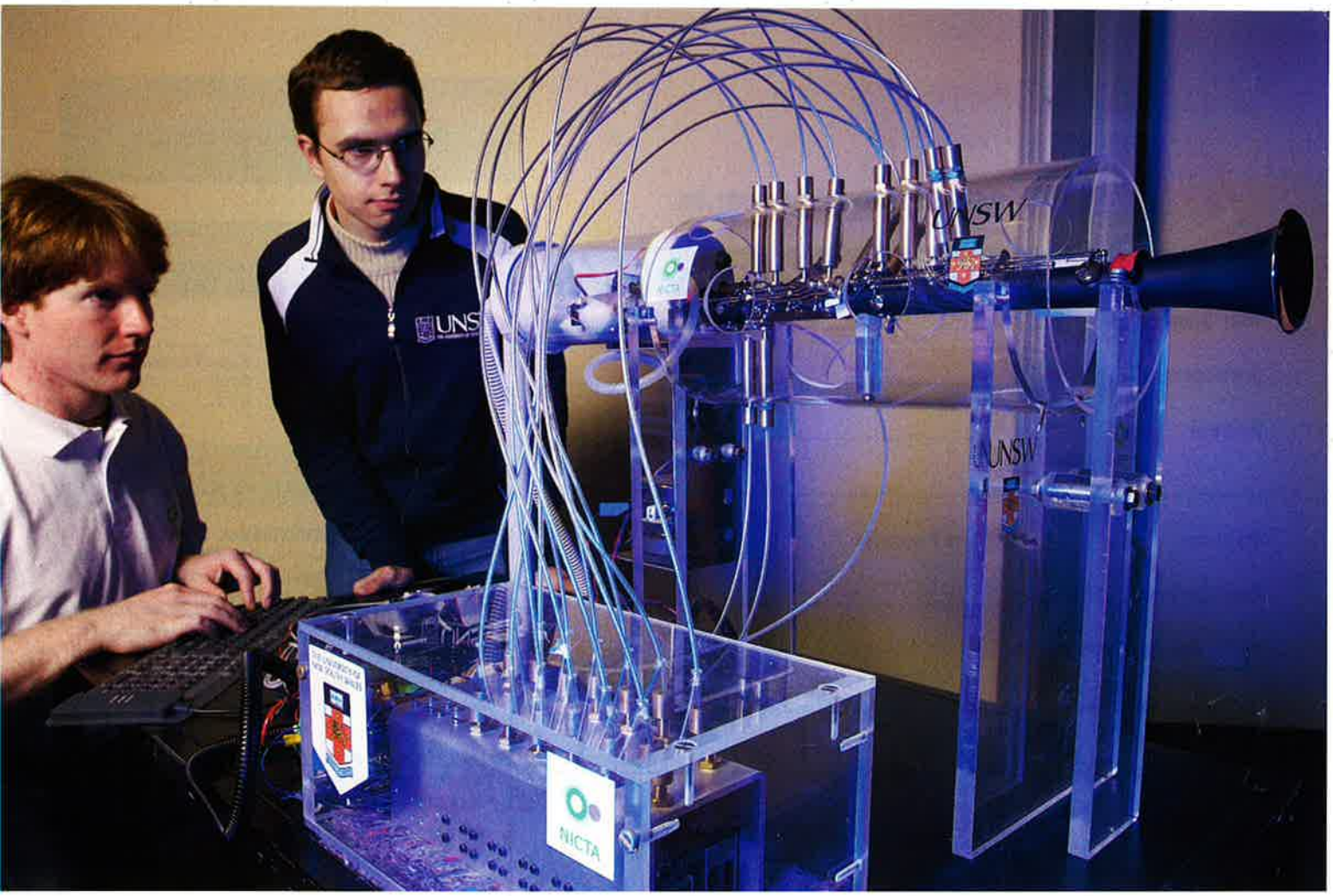
OR

Fax this form to (02) 9939 2648
with your credit card details
24 hours 7 days a week

OR

Mail this form, with your cheque/money order, to:
Silicon Chip Publications Pty Ltd,
PO Box 139, Collaroy, NSW,
Australia 2097

11/08



Robot-Operated Clarinet from NICTA/UNSW wins International competition

A NICTA/UNSW team has won a significant international technology award, winning first place in the ARTEMIS Orchestra competition in Athens with a robotically operated, computer-driven clarinet.

The NICTA/UNSW project, led by NICTA's Dr John Judge, developed the clarinet player over the last eight months.

NICTA is Australia's Information and Communications Technology (ICT) Centre of Excellence, an independent company in the business of research, commercialisation and research training. With over 700 people, NICTA is the largest organisation in Australia dedicated to ICT research.

According to Dr Judge, his team won first place due to the high level of technical difficulty in the design of its robot "mouth" and the device's unique, completely embedded computer system. The clarinet works without an attached PC, the human interface achieved via USB-attached keyboard, LCD screen and LEDs.

The Australian entry played Rimsky-Korsakov's Flight of the Bumblebee and Ravel's Bolero.

The second-placed team from Eindhoven impressed the judges with a robotically driven guitar.

The ARTEMIS Orchestra competition challenges contestants to build devices that play real musical instru-

ments, to demonstrate the creative potential of embedded systems.

Aimed at higher education and universities, the competition is organised by the association of European actors in embedded systems research and development

The robot's "mouth" uses two servomotors that apply force to the clarinet reed to make a sound. The smaller servomotor mimics the action of the human tongue, while the second applies a damping force to the reed, copying the action of the human lip. Force is applied to the clarinet keys by brass plungers with rubber or Nylon feet, depending on the key.

The UNSW's Professor Joe Wolfe, who contributed music acoustics expertise to the project, said a big challenge (as for real-life clarinettists) was to avoid squeaks. This was achieved only a week before the ARTEMIS Orchestra competition, when important circuit boards were completed.

Fortunately, "when we turned it on, it already knew how to play scales, very quickly and accurately," said Professor Wolfe.

The project team included UNSW Computer Science and Engineering student Mr Mark Sheahan, NICTA Project leader Dr John Judge and Dr Peter Chubb, who developed the music interpretation software.

Mechanical design, construction and CAD components were provided by UNSW, including Kim Son Dang and Dr Jay Katupitiya from the School of School of Mechanical & Manufacturing Engineering and Jean Geoffroy and Paul Santus from the School of Physics. The university's Professor John Smith and Professor Joe Wolfe, respectively contributed electronic and music acoustic expertise.

The clarinet will be used by the UNSW School of Physics' Acoustics Lab to better understand the gestures of human players.

A video clip of the robot performing can be seen at **http://nicta.com.au/research/research_themes/embedded_systems/artemis** SC

Want a real speed controller kit?

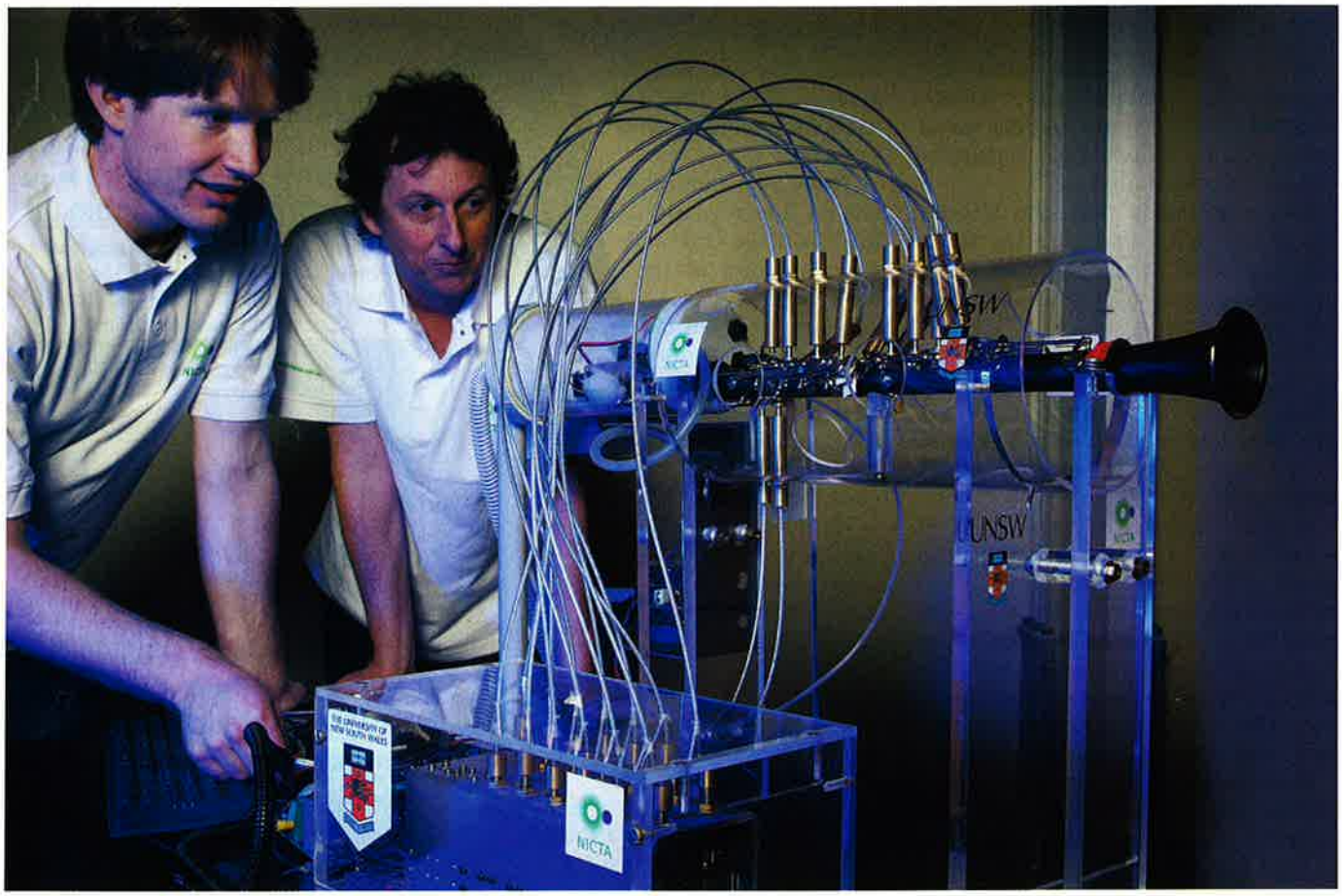
If you need to control 12 or 24 volt DC motors and want a speed controller that will easily handle 30 amps, then this is the kit for you.

This controller allows you to vary the speed of DC motors from 0 to 100%. It is also ideal for controlling loads such as incandescent/halogen lamps and heating elements.

This kit makes a great controller for use on small electric vehicle projects, such as electrically assisted bikes and go-carts. We have tested it to over 30 amps without problems—it barely gets warm! *Item code: SPEEDCON.*

We also have solar maximiser kits, Luxeon LEDs, and lots of interesting products and publications.

Go to shop.ata.org.au or call us on (03)9639 1500.



PRODUCT SHOWCASE

AC LEDS – a simpler LED lighting solution

Unlike conventional high-brightness LEDs which require complex power supply circuitry to drive them, the Acriche range of AC LEDs from Seoul Semiconductor operate directly off the AC mains supply – either 110V or 230V. All you need is a series current-limiting resistor.

They offer designers a simpler lighting solution for many industrial, commercial and consumer lighting applications.

The Acriche LED die contains all the electronic circuitry within either a 2W or 4W conventional high brightness LED package. This eliminates the need for expensive AC/DC converters and reduces the design time for lighting projects.

Furthermore, Acriche LEDs represent a more reliable lighting option than CFLs. At 30% light degradation and with a junction temperature (Tj) below 60°, the product will last for 40,000 Hours. This makes them ideal for demanding applications where maintenance costs must be considered.

Currently the 4W version produces up to 60 lumens/W output. However, the next generation, due for release soon, will deliver up to 80 lumens/W. They are available in either warm white or pure white colour temperatures and can be supplied either as an emitter or with PC board.

Contact:
RMS Parts Pty Ltd
6 Briggs Court, Carindale, Qld 4152
Tel: (07) 3219 4735 **Fax:** (07) 3219 4716
Website: www.rmsparts.com.au

Sandisk CF gets to 32GB!

For all those still battling with 128MB CF (compact flash) cards Sandisk has just announced the biggest ever – 32GB – in their Extreme III range.

At 30MB/s, it also sports a 50% speed increase. Available worldwide now, the RRP in the US is $US299.

The new card will find a ready market amongst professional photographers who shoot in "RAW" format, which demands up to ten times the storage of typical JPGs

Contact:
SanDisk Corporation
601 McCarthy Bvd, Milipitas, California 95035
Tel: (0011 1) 408 801 1000
Website: www.sandisk.com

Ideal "Voltaware" – self-checking NCV tester

A few months back when we featured non-contact mains voltage checkers (NCV), some readers asked "ah, but what if the battery is dead or the checker has failed . . ."

Our reply was that one should never use such a device unless it was checked. Well, here's one that has a self-testing function so you can be sure it's working.

It's from Ideal and is distributed in Australia by Trio-Smartcal. The Ideal 61-025 Cat IV NCV Tester has an inbuilt green LED which comes on when the unit is switched on by twisting the body.

It will indicate the presence of 40 – 1000V AC by changing from a solid green LED to a flashing red one. At the same time a beep sounds in sympathy with the LED flashing rate. This can be turned off by pressing a switch on the tip (that beep can become very annoying very quickly) but the red flashing LED remains.

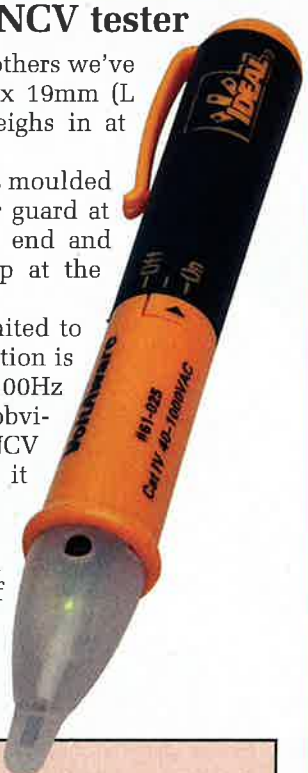
If the battery (2 x AAA cells) drops below 2V the green LED turns off, indicating a battery change is needed.

This tester is a little smaller than some of the others we've seen at 152 x 19mm (L x D) and weighs in at just 46g.

The case is moulded with a finger guard at the business end and a pocket clip at the top end

It's not limited to 50Hz – detection is from 50 to 500Hz so there are obviously other NCV testing roles it could fulfil.

With a recommended retail price of $39.00, this is an "Ideal" addition to any toolbox!



Contact:
Trio-Smartcal Pty Ltd
3 Byfield Street, North Ryde NSW 2113
Tel: 1300 134 091 **Fax:** 1300 134 109
Website: www.fluke.com.au

ANTRIM TRANSFORMERS
manufactured in Australia by
Harbuch Electronics Pty Ltd
harbuch@optusnet.com.au
Toroidal – Conventional Transformers
Power – Audio – Valve – 'Specials'
Medical – Isolated – Stepup/down
Encased Power Supplies

Encased Power Supply
www.harbuch.com.au
Harbuch Electronics Pty Ltd
9/40 Leighton Pl, HORNSBY 2077
Ph (02) 9476 5854 Fax (02) 9476 3231

New capabilities for Fluke 287 and 289 meters

A free software package for the Fluke 287 and 289 True-RMS Logging Multimeters delivers a variety of functional key new features. These include zoom on trend which provides unprecedented ability to view and analyse data and see detail at X5 magnification; rotary switch memory when switching positions between AC or DC A/mA and uA, new and improved Trend View graph plot.

A new algorithm plots the minimum, maximum and sample point for each sample interval record and event record and new adjustable recording and auto hold thresholds enable users to specify a percentage change in the readings that will begin a new event.

The new Firmware V1.1 is the first such update since the Fluke 287 and 289 were introduced in October 2007.

The Fluke 287 and 289 Digital Multimeters are designed from the start to be expandable and field upgradeable.

To download the Firmware V1.1 for free, owners can visit www.fluke.com.au/auen/support/software/Digital+Multimeter+Upgrades.htm and follow instructions there.

Contact:
Fluke Australia Pty Ltd
Unit 26, 7 Anella Ave, Castle Hill, 2154
Tel: (02) 8850 3333 Fax: (02)-8850-3300
Website: www.fluke.com.au

World's smallest, lightest full-range in-ear 'phones

Not only are the Klipsch Image X5 headphones the world's smallest and lightest full-range in-ear headphone, each Image model comes with five different sizes of Contour Ear Gels that are designed to fit comfortably inside the human ear canal: small, medium, and large single flange designs, as well as small and large double flange designs.

These soft, oval silicone tips reduce ear fatigue and provide an amazing seal for excellent noise isolation and increased bass response.

They feature silver-grey bodies, black tails and 50-inch (1.2M) vinyl cables with stretch relief built in.

Recommended retail price is $299.

Contact:
Powermove Distribution
14 Centofanti Pl, Thomastown Vic 3078
Tel: (03) 9464 4999 Fax: (03) 9464 7799
Website: www.powermove.com.au

Weatherproof outdoor mains "Powerstake"

Getting ready to run power to the Christmas lights? Or maybe you simply need a safe outlet for mains power outside?

Jackson Industries' PowerStake gives three overload-protected outlets, a master off/on switch and a 5 metre power cord, all in a weatherproof (IP34) "stake" designed to push into garden beds, lawn, etc – or mount on a wall (with the stake and bracket included. A flip-down cover protects the sockets from the elements.

No electrician is needed for installation. The Powerstake is now available at major retail stores for $39.95 rrp (Cat. No. PT3735).

Contact:
Jackson Industries
Norwest Busn Park, Baulkham Hills NSW 2153
Tel: (02) 9899 8833 Fax: (02) 9899 8378
Website: www.ji.com.au

Ozitronics
Tel: (03) 8677 1411 Fax: (03) 9011 6220
Email: sales2008@ozitronics.com

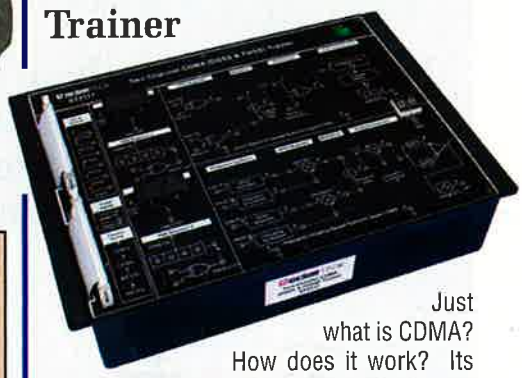
New voice recorder kits using ISD1700 series ICs

The sampling frequency can be set from 4kHz to 12kHz with external resistor, giving greater flexibility in duration versus recording quality. Non-volatile storage. Standalone or microcontroller (SPI) operating mode. All inputs & outputs via standard connectors. Onboard microphone. See docs for details

K188 (40 sec)....$46.20
K189 (120 sec)..$49.50

More kits and all documentation available on website:
www.ozitronics.com

Two-channel CDMA Trainer



Just what is CDMA? How does it work? Its invasion into everyday life is vast but many involved intimately with electronics and communications really haven't any idea about it.

The ST2117 Trainer, distributed in Australia by Geo Electronics, is a comprehensive training solution for technology people who want to explore the basics behind CDMA.

It is a two-channel CDMA (DSSS and FHSS) trainer that gives necessary understanding of the CDMA multiplexing. It has data generators and PN Sequence generators, along with numeric displays for transmitted and received data for both DSSS and FHSS.

It includes DSSS and FHSS modulators and a multiplexer, DSSS and FHSS demodulators, variable data rate chip rate selection for DSSS and frequency synthesisers for FHSS.

The Indian-made trainer operates from standard 230V mains, measures 325 x 255 x 90 (wxdxh) and weighs approx. 1.1kg.

Geo Electronics offer comprehensive training solutions in Electronics and Communications through their extensive range of training systems. SC

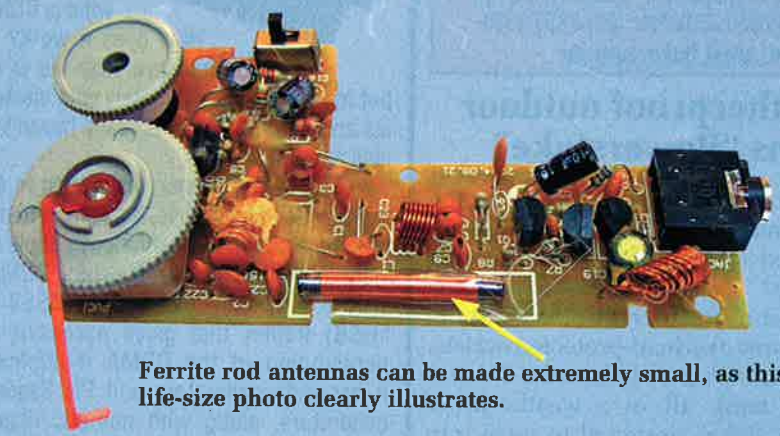
Contact:
Geo Electronics
Tel: 0401 687 587 Fax (02) 9755 1858
email: geoelectronics@engineer.com
Website: www.scientech.bz

Vintage Radio

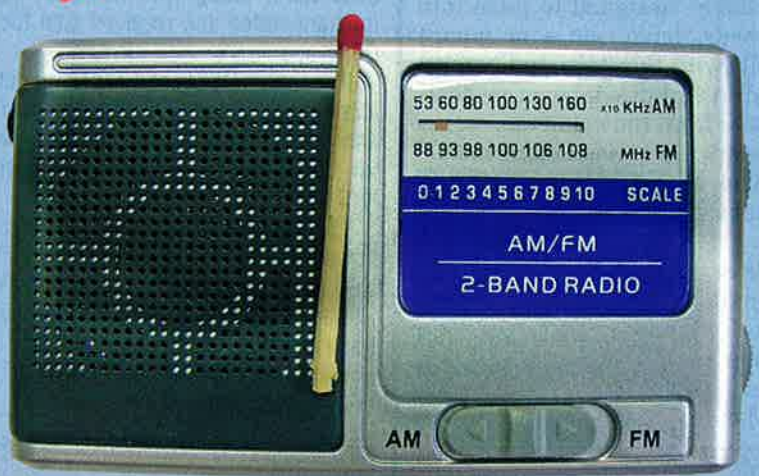
By RODNEY CHAMPNESS, VK3UG

Those mysterious antenna coils & loop antennas

Ever wondered about those mysterious antenna coils used in vintage radio receivers, or about those old-style loop antennas? This article unravels some of the mysteries.



Ferrite rod antennas can be made extremely small, as this life-size photo clearly illustrates.



This small AM/FM receiver uses the PC board shown above and is intended for use in strong signal areas only. It's miniature ferrite rod antenna means that its AM performance is pathetic compared to larger sets.

Broadcast-band radio signals are radiated from tall masts that are fed from nearby transmitters. One way to receive these radio signals is to put up an external wire antenna that's as high and as long as possible. One end of this antenna wire is brought down to the receiver and attached to the aerial terminal, while an earth wire is connected to the earth terminal (valve radio chassis were often not earthed back through the mains).

This type of "long-wire" antenna system largely responds to the electric component of the radio waves.

Another way to intercept these signals is to use a loop antenna. They vary widely in size, ranging from antennas consisting of several turns of wire which form a coil about one metre in diameter to very small, ferrite-cored loopstick antennas. Loop antennas couple to the magnetic component of the radio waves.

Both loop and long-wire antennas have been used since radio began.

Long wire antennas

Many vintage radio restorers have probably been puzzled as to why some receivers need only a small antenna to perform well, while others need a large antenna to give the same result.

The simple answer is that some sets require large antennas because they are either low-performance types or because they have faults which seriously degrade their performance. However, if we assume that a set is well-designed and that its sensitivity from the input of the converter onwards is good, then the only component that should further influence performance is the antenna coil.

By necessity, antennas are some-

thing of a compromise between size and performance. The best antenna for a broadcast radio is theoretically a quarter-wave unit fed against earth. However, this is hardly practical as at 531kHz, a quarter-wave antenna would be 141 metres long.

In fact, our so-called "long wire" antennas are still short when compared with a quarter-wave antenna at 1602kHz, as the latter is 47 metres long. This means that various techniques must be used to increase the effectiveness of wire antennas that are much shorter than the optimum length.

One simple method (as used in my crystal set in the April 2007 issue) is to employ an adjustable coil in series with the antenna. This adjustable coil resonates the antenna to the frequency being received and is commonly called a "base-loaded antenna" system. It worked well in my crystal set which was able to receive stations up to 300km away at comfortable headphone volume.

Early methods

The very early antenna-to-receiver coupling methods were designed to extract the maximum amount of signal from the antenna system. This was necessary because there was no amplification in those early receivers to boost the signal fed to the detectors which were based on inefficient coherers and cat's whiskers. Because of this, the antennas employed were huge in many cases.

With the advent of valves, it became practical to amplify the incoming signal and complex antenna coupling/matching systems were no longer needed. In fact, if you look at the circuits of some very early pre-valve receivers, you will see that there were many adjustments that could be made to achieve best reception. It was also quite easy to get these wrong and not receive a signal at all.

By simplifying the antenna-to-valve matching circuitry, receiver tuning became a much less arduous undertaking. It was now only necessary to adjust the tuning and the regeneration controls (pre-superhet receivers), although correct adjustment of the regeneration could be tricky. Often, in those early days, the lady of the household was not allowed to even touch such a technologically advanced piece of equipment!

Placing a portable AM radio inside a tuned loop antenna can dramatically improve the reception.

The antenna coils in these early regenerative receivers coupled the energy from the antenna via a primary winding into the secondary tuned winding. This coupling was quite arbitrary. In addition, another coil was wound at the opposite end of the secondary tuned winding and this functioned as the feedback winding for the regeneration control.

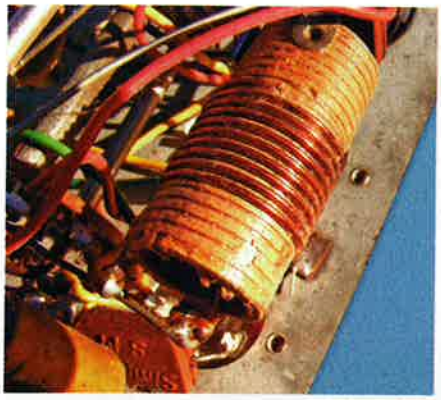
Simplifying the controls

If you look back at the many circuits published on simple regenerative receivers, you will see that the coil diameters, wire gauges, number of turns used on each winding and their spacing, etc, varied so widely that no real design concept could be discerned. There was often little science involved in the process but quite large external antennas were still being used at that time so it didn't really matter that the antenna system was not well-matched to the receiver's input.

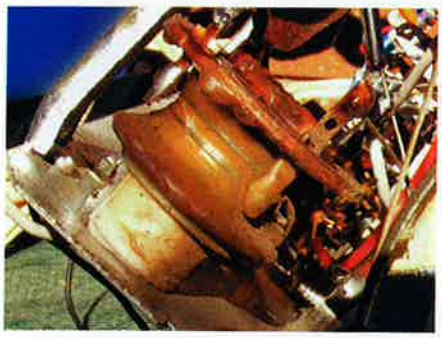
Things gradually changed as radio/wireless progressed out of the experimenter's realm. Experimenter's had prided themselves on getting good reception from their receivers and had relied on large antenna systems, substantial earths and their ability to fiddle with the adjustments on their receivers to extract maximum performance.

By the early 1930s, a new group of radio users had appeared who wanted to just turn the set on and enjoy the program. They were not interested in large antennas or fiddly receiver adjustments and most lacked the ability to even make these adjustments.

As a result, manufacturers could see that they had to design receivers that were usable by the average citizen. Innovations to achieve this included superheterodyne reception, automatic volume control (AVC/AGC), single knob tuning, loudspeaker output and the ability to operate from much



This shortwave coil is from an Operatic 32V receiver and is designed to cover the 6-18 MHz band.



This antenna coil is from an HMV Little Nipper and is made for the AM broadcast band.

smaller antennas than the 30m-long 10m-high standard of the time.

The trend to much small antennas in turn meant that the antenna coil had to be designed to suit the set's application. For example, the antenna coils for sets used on the broadcast band in country areas were different from those used in a high-density suburban environment where antennas were invariably much smaller.

Similarly, car radio antennas are necessarily short, while most antennas used to receive shortwave frequencies are somewhere near a resonant length on some bands at least.

As a result, there are four different philosophies used in the design of antennas and antenna coils for domestic receivers. We'll look at these in turn.

Car radio antennas

In common with other sets of the time, Australian-built car radios used a very short antenna, typically around a metre or so long. This antenna was connected via a coaxial cable to the top of the aerial coil via a matching network (see Fig.1).

The coaxial cable acts as a shield to minimise interference and its braid is earthed at both the receiver and at the antenna base. In practice, it forms part of the antenna tuned circuit and the set must be tuned during installation to match the antenna.

Note that a special type of coaxial cable with very low capacitance was used. The characteristic impedance was 110 ohms. Any change in the antenna length or the characteristics of the coaxial cable (or its length) meant that the antenna coil trimmer had to be readjusted for best performance at around 1400kHz.

Substituting a big antenna on a car radio will rarely improve the reception. However, one company (Walbar) did produce some 2.7-metre long antennas, which could be mounted at the back of the vehicle. A long coaxial cable was then run from the set to the antenna.

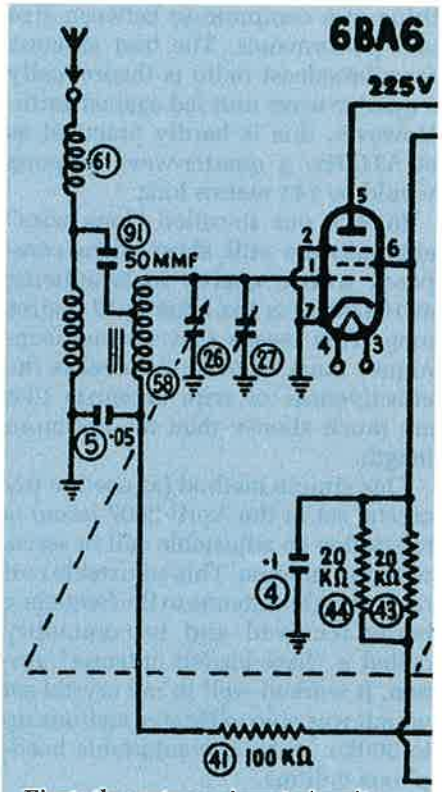


Fig.1: the antenna input circuit for an Astor JL car radio. The antenna was coupled to the top of the aerial coil via a matching network (61).

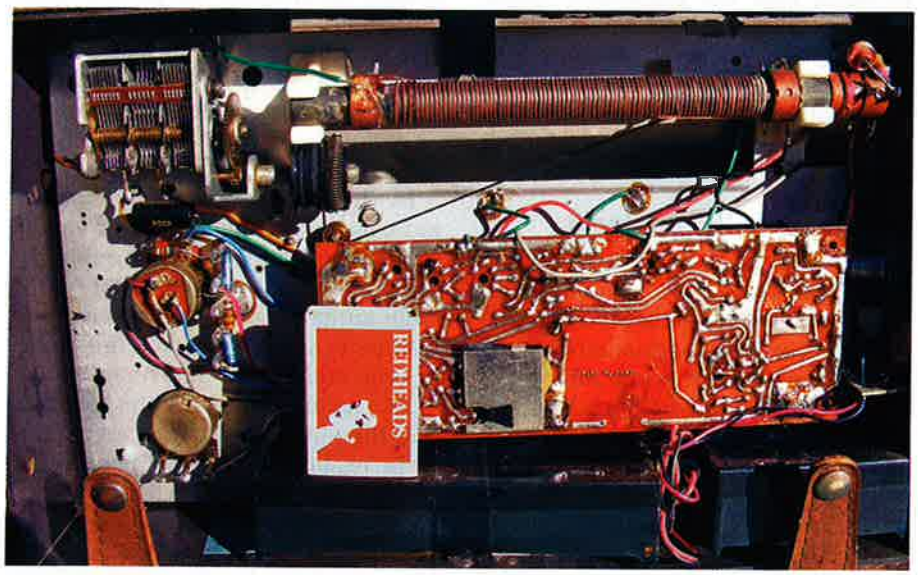
Normally, this would have meant that the cable capacitance would be too great to be compensated for by the antenna coil trimmer. To overcome this, Walbar made an adaptor that fitted part way along the coaxial cable. It simply consisted of a capacitor which was wired in series with the inner conductor.

This reduced the apparent capacitance across the coaxial cable at the receiver and the circuit could then be peaked satisfactorily.

Suburban antenna

In the suburbs, radio signals were fairly strong, so relatively small antennas could be used to achieve quite acceptable results. In fact, the average domestic suburban receiver of the 1940s and 1950s was expected to perform well on an antenna 6-10 metres long. This was often strung indoors around the picture rail as people couldn't be bothered putting up a suitable outside antenna.

Of course, the manufacturers had



A full-size ferrite rod antenna was used in the AWA B32 8-transistor radio from the mid-1960s. This set was quite an impressive performer.

siliconchip.com.au

to find a way to get good performance with such short antennas and this was achieved in short order.

As mentioned above, I achieved good performance from my crystal set by using an adjustable loading coil in series with the antenna tap on the tuning coil. However, using this technique on domestic radio was never going to be accepted by the non-technical public.

The way around the problem was to design the aerial coil primary to have a reasonably high impedance and to be broadly resonant at a frequency somewhere around 320-420kHz (ie, below the lowest tuned frequency). This gave a rising response/sensitivity at the low end of the broadcast band, although some coils also required an external 100pF capacitor across the primary.

The coupling to the secondary was relatively light, so that changing an antenna wouldn't upset the tuning of the secondary coil. The performance at the high-frequency end of the band was enhanced by wiring a low-value capacitor from the top of the primary winding to the top of the secondary winding.

Typical values for this capacitor ranged from 2-5pF or it could simply be formed by connecting a lead to the primary winding and laying it close to the secondary.

Basically, the coil was optimised to give high sensitivity on the BC (broadcast) band with a short antenna and substituting larger antennas gave little improvement. Another advantage was that using differing antenna lengths or antennas with different characteristics did not cause any severe detuning of the circuit.

Most manufacturers of domestic household valve receivers used variable-gang tuning capacitors. There were some exceptions though and Astor was one of the few that also used inductance tuning of the antenna (and oscillator) circuits. A typical circuit is shown in Fig.2.

In that circuit, the antenna impedance is matched to that of the valve using capacitors 45, 11 & 16. This matching remains substantially the same across the broadcast band. No series-loading coil was used.

Country antennas

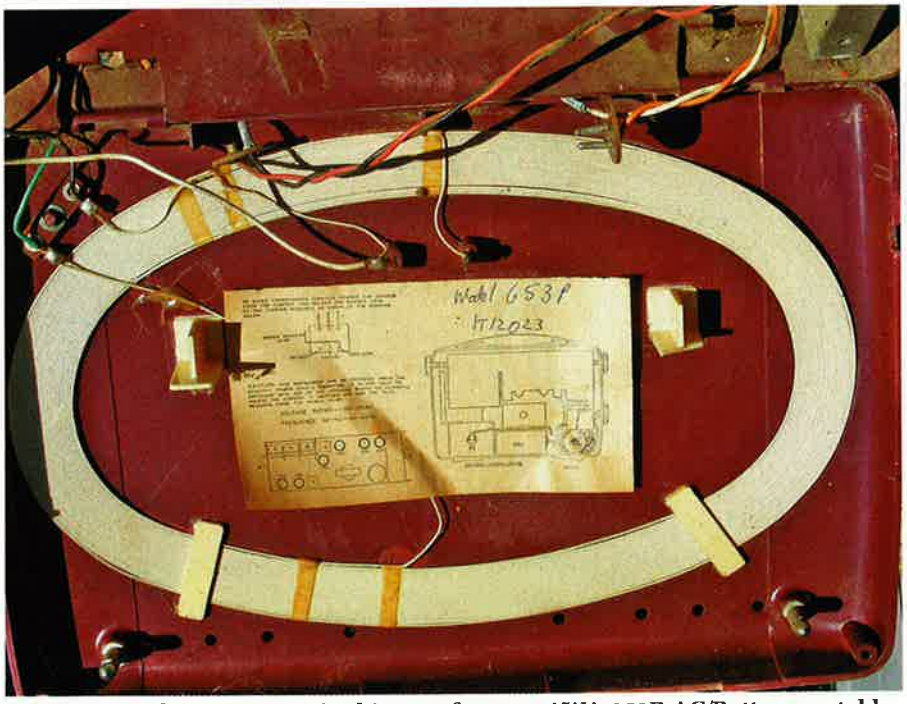
The antenna coils fitted to receivers in country areas were more like those used in early sets. Basically, the design concept was similar to that used in the suburban sets but the antenna coil was designed for optimum performance with a larger antenna.

Receivers for country areas were generally more sensitive than their suburban counterparts to enable them to pick up signals in regions remote from radio stations. AM commercial broadcasting stations in the heyday of valve radios generally used 5kW transmitters in the city and 2kW transmitters in the country. This now seems rather odd, as a country audience would have been spread over a greater distance compared to the audience in the city. Higher-powered stations in the country would have been more logical, not the other way around.

Because country signals were weaker, radios were commonly fitted with a radio frequency (RF) stage to boost their sensitivity. In addition, a long outside antenna was usually necessary to ensure that a good signal was fed to the receiver. An outside antenna was also necessary to avoid picking up in-home electrical interference.

Shortwave antennas

Shortwave antenna coils were designed to mate with long antennas too. They are often solenoid wound with the primary and secondary in close proximity to one another.



A typical flat-loop antenna, in this case from an AWA 653P AC/Battery portable receiver (circa 1954). It was attached to the inside back of the cabinet.

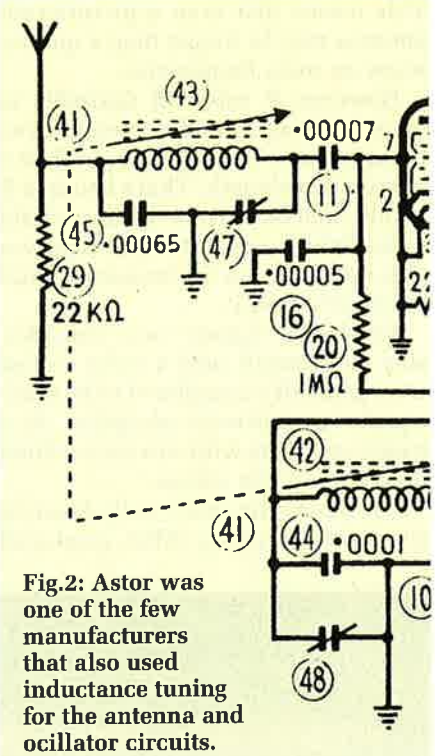


Fig.2: Astor was one of the few manufacturers that also used inductance tuning for the antenna and ocillator circuits.

In reality, their design was very much a compromise and the sets to which they were fitted often used an RF stage to increase the gain, to make up for the barely adequate antenna and RF coils.

When tuning the common 6–18MHz shortwave band, a quarter-wave an-

The loop antenna for this 1925 RCA 26 portable radio receiver is contained in the hinged section at left. It can be rotated for optimum reception.

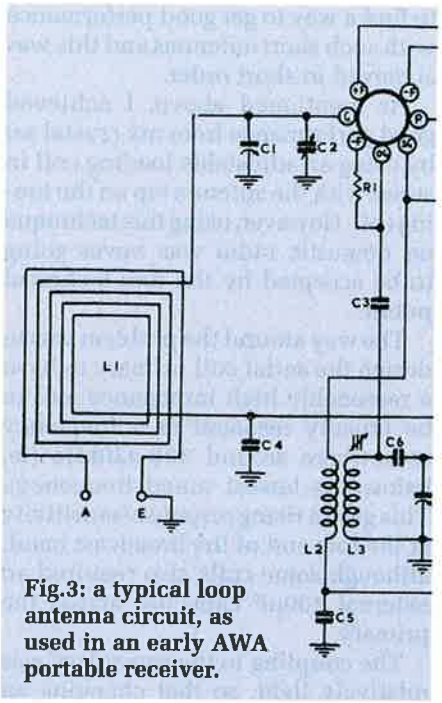


Fig.3: a typical loop antenna circuit, as used in an early AWA portable receiver.

tenna will vary from 4.2 metres long at 18MHz to 12.5 metres long at 6MHz. This means that even a picture-rail-antenna may be longer than a quarter wave on some frequencies.

However, it was still desirable to have a decent outside antenna even though it may be much longer than a quarter wavelength. That's because it would then be outside the household noise field (a consideration that was also important on the broadcast band in country areas).

Shortwave signals vary considerably in strength and 4-valve radios were generally considered to be inadequate for shortwave reception. As a result, most sets with shortwave fitted used at least five valves.

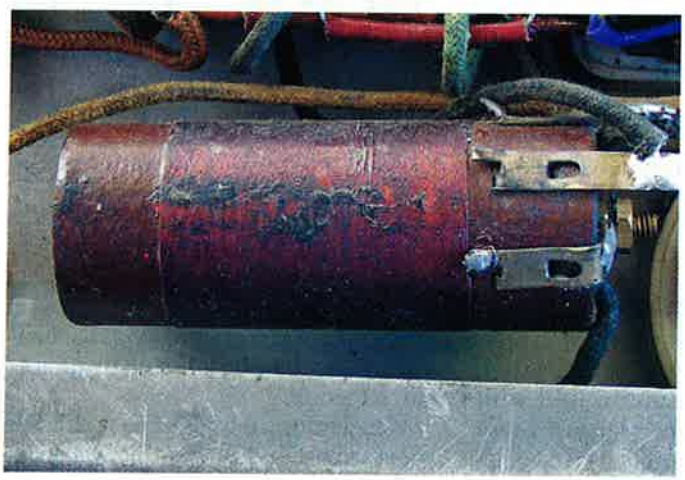
For those who were really keen on shortwave listening, AWA produced sets like their famous 7-band, 6-valve sets, while Astor and HMV produced receivers capable of covering several international shortwave broadcast bands. The antenna coils used in the Astor sets consisted of a single winding coupled to the antenna by a 4pF mica capacitor.

Resonant antennas

Antenna coils designed for use with resonant antennas (eg, those used by radio amateurs) are different again.

In this case, the antenna coil winding is designed to suit the impedance of the antenna. The primary winding may have one end earthed or it may have both ends floating so they can be attached to a resonant dipole antenna or to a balanced feeder cable.

This floating winding may also have a centre tap, which is earthed. The purpose of this is to balance the two sections of the coil and to act as an earth to discharge any static-charge build-ups on the antenna.



Left: a solenoid-type aerial coil as used in the Raycophone "Pee Wee" AM radio from about 1933.

Loop antennas

Loop antennas were developed around the same time as long-wire antennas. They were a very convenient way of receiving signals, as they didn't require the construction of a large outside structure. However, they did require a frame up to about one metre in diameter to accommodate the antenna coils and this was usually installed on top of the receiver or incorporated into the cabinet.

As time went by, the loop diameter progressively decreased and there were a few reasons for this. First, the strength of the signals increased due to broadcasting stations increasing their output power and improving the antenna systems. Second, various components such as valves improved and so receivers became more sensitive. As a result, smaller loop antennas gave the same end result as a larger loop antenna in earlier days.

Another reason was that consumers wanted the antenna to be less intrusive and they wanted their receivers to be more portable, so that they could be easily moved from room to room.

The original loop antennas consisted of several turns wound around a wooden frame. These turns were

siliconchip.com.au

spaced well away from each other to minimise any inter-winding capacitance. The tuning capacitor was mounted inside the receiver and was connected to the antenna loop by two flexible wires, ie, one to each end of the winding.

Loop antennas had one feature that proved invaluable if there were two strong stations on adjacent frequencies. By rotating the loop, the unwanted station could be almost completely nulled out so that it did not cause interference to the wanted station, a feature that can still be important today.

This particular characteristic was also used in direction finding receivers during the war, to determine where a transmitting station might be.

By 1925, loop antennas had been reduced down to quite manageable sizes. The loop antenna used in the RCA 26 receiver featured in the August 2008 issue illustrates this.

It's also worth noting that when loopstick antennas became the fashion, the primary winding (which is attached to the antenna) was more like that used in the antenna coils for amateur radio receivers. However, they also featured an RF choke (wound on a resistor) in series with the antenna lead and this basically acted as a loading coil.

This allowed the set to be peaked with an "average" antenna to some spot on the broadcast band. The resistor loaded the coil and reduced its "Q", so that this peaking effect was spread out over a much larger section of the broadcast band, ie, the peaking effect at the resonant frequency of the antenna and loading coil was significantly reduced.

Portable receivers

Portable radio receivers have used loop antennas of some sort almost since radio began. A typical antenna in such sets (before ferrite rod antennas became common) consisted of a flat coil which was usually in the back of the receiver case (eg, as in the AWA 653P featured in the September 2008 issue). The loop also generally had a 2-turn primary winding that could be connected to an external antenna and earth.

Astor sets often used a damped loading coil in series with their loop antennas, as subsequently used with many ferrite rod antennas.

Photo Gallery: Peter Pan BKJ

The Peter Pan BKJ was manufactured around 1946 by Eclipse Radio in Melbourne and this particular example was restored by Bill Smith. It employed a conventional superhet circuit and the valve line-up was as follows: 6J8G mixer, 6U7G IF amplifier, 6B6G detector/first audio amplifier, 6V6G audio output and 5Y5G rectifier. Photo by Kevin Poulter for the Historical Radio Society of Australia (HRSA). Phone (03) 9539 1117. www.hrsa.net.au

Some personal portables even used a carrying strap embedded with tinselled wire as the loop antenna. This was not tuned but was wired in parallel with the tuned antenna coil primary.

A typical "pocket-portable" AM radio from the 1970s. The small loopstick antenna is at the top and gave adequate performance on strong local stations.

Summary

Antenna coils, whether attached to external antennas or used to receive signals directly (as loop antennas do), were all designed to suit their particular application. Large loop antennas like those shown in the photos are extremely efficient. If a small transistor portable is placed within such a loop antenna, the performance of the set will be markedly improved when the loop is tuned to the station of interest and rotated for maximum pickup.

Ferrite rod antennas are now used in virtually all AM broadcast band receivers. Their development (along with the invention of transistors) meant that receivers could be made much smaller than before and still work satisfactorily in most areas.

Ferrite rod antennas can be made extremely small, as can be seen in a photograph at the start of this article. In that case, the ferrite rod is about half the size of a matchstick! Of course, the set's performance is pathetic compared to sets with ferrite rods like that used in the AWA B32. SC

SILICON CHIP REFERENCE BOOKSHOP

SELF ON AUDIO

by Douglas Self **2nd Edition 2006**

The very latest from the renowned audio design guru. A collection of 35 classic magazine articles offering a dependable methodology for designing audio power amplifiers in a way that improves performance at every point without significantly increasing cost. Includes compressors/limiters, hybrid bipolar/FET amps, electronic switching and more. 474 pages in paperback.

$83

AUDIO POWER AMPLIFIER DESIGN HANDBOOK by Douglas Self 4th Edition 2006

Reduced in price from previous edition! From one of the world's most respected audio authorities. New 4th edition is more comprehensive than ever – now with new chapters on Class D amplifiers and DC servos. Now even bigger – 465 pages in paperback. ***See the review in September 2006 issue.***

$87

PRACTICAL VARIABLE SPEED DRIVES AND POWER ELECTRONICS

by Malcolm Barnes. 1st Ed, Feb 2003.

An essential reference for engineers and anyone who wishes to design or use variable speed drives for induction motors. As reviewed in Silicon Chip September 2003. 288 pages.

$94

AUDIO ELECTRONICS

By John Linsley Hood. Second edition 1999.

For anyone involved in designing, adapting and using analog and digital audio equipment. Covers tape recording, tuners and receivers, preamplifiers, voltage amplifiers, audio power amplifiers, compact disc technology & digital audio, test & measurement, loudspeaker crossover systems, power supplies and noise reduction systems. 375 pages in soft cover.

$101

MICROCONTROLLER PROJECTS IN C FOR THE 8051 by Dogan Ibrahim. Published 2000.

Through graded projects introduces the fundamentals of microelectronics, the 8051 family, programming in C and the use of a C compiler. Provides an interesting, enjoyable and easily mastered alternative to more theoretical textbooks. 178 pages in paperback.

$81

ANALOG ELECTRONICS

By Ian Hickman. 2nd edition 1999.

Essential reading for electronics designers and students alike. It will answer questions about core analog theory and design principles as well as offering practical design ideas. Many of the circuits taken from Ian Hickman's magazine articles. 294 pages in soft cover.

$100

POWER SUPPLY COOKBOOK

by Marty Brown. 2nd edition 2001.

An easy-to-follow, step-by-step text for a wide variety of power supplies. All described in simple language. Anyone with a basic knowledge of electronics can create a very complicated power supply design. 265 pages in paperback.

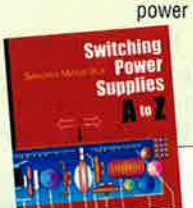
$109

OP AMPS FOR EVERYONE

Edited by Ron Mancini Published 2003

Compiled by Texas Instruments, this is the closest thing to a "bible" on op amps. This is an engineer's reference with lots of theory, plenty of maths and right up-to-the-minute with modern devices. Not cheap but worth every cent. 478 pages, soft covers.

$137



SWITCHING POWER SUPP. A to Z

by Sanjaya Maniktala. Published 2006.

Theoretical and practical aspects of controlling and measuring electromagnetic interference in switching power supplies. Includes flow-charts for building DC-DC converters and their magnetic components under typical wide-input supply conditions. 503 pages in hard cover.

$106

CD-ROM included.

RF CIRCUIT DESIGN

by Chris Bowick, Second Edition, 2008.

A new edition of the classic RF circuit design book. RF circuit design is now more important that ever in the wireless world in which we live. In most of the wireless devices that we use there is an RF component – this book tells how to design and integrate in a very practical fashion. 244 pages in paperback.

$67

DVD PLAYERS AND DRIVES

by K.F. Ibrahim. Published 2003.

A guide to DVD technology and applications, with particular focus on design issues and pitfalls, maintenance and repair. Ideal for engineers, technicians, students of consumer electronics and sales and installation staff. As reviewed in Silicon Chip February 2004. 319 pages in paperback.

$85

PRACTICAL RF HANDBOOK

by Ian Hickman **4TH EDITION 2006**

The latest guide to RF design for engineers, technicians, students and enthusiasts. Covers key topics in RF: analog design principles, transmission lines, couplers, transformers, amplifiers, oscillators, modulation, transmitters and receivers, propagation & antennas. 279 pages in paperback.

$80

ANALOG TECHNIQUES WITH DIGITAL INTERFACING

by T H Wilmshurst – Published 2001.

Covers all the analog electronics needed in a wide range of higher education programs: first degrees in electronic engineering, experimental science course, MSc electronics and electronics units for HNDs. Supported by numerous worked examples and experimental exercises. 312 pages paperback.

$88

PIC IN PRACTICE by D W Smith.

2nd Edition - published 2006

Based on popular short courses on the PIC, for professionals, students and teachers. Can be used at a variety of levels. An ideal introduction to the world of microcontrollers. 255 pages in paperback.

$60

ELECTRIC MOTORS AND DRIVES

By Austin Hughes - Third edition 2006

Brand new edition of this amazingly popular book. Intended for non-specialist users of electric motors and drives, filling the gap between academic texts and general "handbooks". Explores all of the widely-used modern types of motor and drive including conventional & brushless DC, induction motors, steppers, servos, synchronous and reluctance. 384 pages, soft cover

$55

PIC MICROCONTROLLER – PERSONAL INTRODUCTORY COURSE

By John Morton 3rd edition 2005.

A unique and practical guide to getting up and running with the PIC. It assumes no knowledge of microcontrollers – ideal introduction for students, teachers, technicians and electronics enthusiasts. Revised 3rd edition focuses entirely on re-programmable flash PICs such as 16F54, 16F84 12F508 and 12F675. 226 pages in paperback.

$52

PIC MICROCONTROLLERS: know it all

By di Jasio, Wilmshurst, Ibrahim, Morton, Bates, Smith, Smith and Hellebuyck

The best of subjects Newnes authors have written over the past few years, combined in a one-stop maxi reference. Covers introduction to PICs and their programming in Assembly, PICBASIC, MBASIC & C. More than 900 pages paperback.

$79.95

PROGRAMMING 16-bit MICROCONTROLLERS IN C By Luci di Jasio (2007)

Subtitled Learning to Fly the PIC 24, A Microchip insider tells all on the newest, most powerful PICs ever! Condenses typical introductory "fluff" focusing instead on examples and exercises that show how to solve common, real-world design problems quickly. Includes handy checklists. FREE CD-ROM includes source code in C, the Microchip C30 compiler, and MPLAB SIM. 400 pages paperback.

CD-ROM included.

$80.50

ROBOT BUILDER'S COOKBOOK

By Owen Bishop Published 2007

The PIC microcontroller throughout provides a painless introduction to programming. It's a book for first-time and advanced robot builders and those studying at higher education levels in this fascinating field. Has companion website to download programs. 374 pages in paperback

$63

HANDS-ON ZIGBEE

By Fred Eady, Published 2007

We asked our Zigbee guru, Telelink's Jack Chomley, to comment on this book and he said "wow! This one is right up to date". A lot of it is pretty in-depth but, according to Jack, if you want to learn all about Zigbee you'd go a long way to find a better reference than this one. 336 pages in paperpback.

$96.50

NEWNES GUIDE TO TELEVISION & VIDEO TECHNOLOGY

By KF Ibrahim 4th Edition (Published 2007)

It's back! Now in a new edition provides a full and comprehensive coverage of video and television technology including HDTV and DVD. Starts with fundamentals so is ideal for students but covers in-depth technologies such as blu-ray, DLP, Digital TV, etc so is also perfect for engineers. 600+ pages in paperback

$60.50

THE PRACTICAL GUIDE TO SATELLITE TV

By Garry Cratt – 6th Edition 2007

We've had other satellite TV books in the past but they have all had a lot of useless (to this part of the world) overseas stuff. This one is written in Australia, for Australian conditions by one of Australia's foremost satellite TV experts. If there is anything you wanted to know about setting up a satellite TV system, (including what you can't do!) it's sure to be covered in this 176-page paperback book

$49

AC MACHINES By Jim Lowe Published 2006

Applicable to Australian trades-level courses including NE10 AC Machines, NE12 Synchronous Machines and the AC part of NE30 Electric Motor Control and Protection. Covering polyphase induction motors, single-phase motors, synchronous machines and polyphase motor starting. 160 pages in paperback.

$66

10% OFF!

WANT TO SAVE 10%? SILICON CHIP SUBSCRIBERS AUTOMATICALLY QUALIFY FOR A 10% DISCOUNT ON ALL BOOK PURCHASES!

RADIO, TV AND HOBBIES April 1939 to March 1965

– Every article to enjoy once again on DVD-ROM!

This remarkable archival collection spans nearly three decades of Australia's own "Radio and Hobbies"/"Radio TV and Hobbies". Every article has been scanned into PDF format – ready to read at your leisure on your computer (obviously, a computer DVD-ROM reader is required along with Acrobat Reader 6 or later). For history buffs, it's worth its weight in gold. For vintage radio enthusiasts, what could be better? For anyone interested in electronics, this is one which you ***MUST*** have in your collection! **NB: Does not play on audio DVD players.**

$62

AMATEUR SCIENTIST TWIN CD SET – *NOW NEW* V3.0: *Includes bonus science software library*

Many thousands of copies now sold. Two incredible CDs containing over 1000 classic projects, sourced from Scientific American over the past 73 years – and covering every field of science. This new "Dr Shawn" edition is the latest version – it's said to be even more user friendly with much more information and data. Runs with any browser (on Win2000 or later). Recommended by the National Science Teachers Association (USA).

$62

ORDER HERE

☐ AC MACHINES	$66.00
☐ AMATEUR SCIENTIST CD	$62.00
☐ ANALOG CIRCUIT TECHNIQUES W/DIGITAL INT.	$88.00
☐ ANALOG ELECTRONICS	$100.00
☐ AUDIO ELECTRONICS	$101.00
☐ AUDIO POWER AMPLIFIER DESIGN	$85.00
☐ DVD PLAYERS AND DRIVES	$85.00
☐ ELECTRIC MOTORS AND DRIVES	$55.00
☐ HANDS-ON ZIGBEE	$96.50
☐ M'CONTROLLER PROJECTS IN C FOR 8051	$81.00
☐ NEWNES GUIDE TO TELEVISION AND VIDEO TECHNOLOGY	$60.50
☐ OP AMPS FOR EVERYONE	$137.00
☐ PIC IN PRACTICE	$60.00
☐ PIC MICROCONTROLLER - KNOW IT ALL (NEW!)	$79.95
☐ PIC MICROCONTROLLER - PERSONAL INTRO COURSE	$52.00
☐ POWER SUPPLY COOKBOOK	$109.00
☐ PRACTICAL GUIDE TO SATELLITE TV (6th edition)	$49.00
☐ PRACTICAL RF HANDBOOK	$80.00
☐ PRACT. VARIABLE SPEED DRIVES/POWER ELECT.	$94.00
☐ PROGRAMMING 16-BIT MICROCONTROLLERS IN C (NEW!)	$80.50
☐ RADIO, TV AND HOBBIES ON DVD-ROM	$62.00
☐ RF CIRCUIT DESIGN	$67.00
☐ ROBOT BUILDER'S COOKBOOK	$63.00
☐ SELF ON AUDIO (2nd_ edition)	$83.00
☐ SWITCHING POWER SUPPLIES A-Z (inc CD-ROM)	$106.00

NOTE: ALL PRICES ARE PLUS P&P – AUSTRALIA ONLY: $7.00 per order NZ – $12.00 PER BOOK; REST OF WORLD $18.00 PER BOOK

TAX INVOICE – SILICON CHIP PUBLICATIONS ABN 49 003 205 490

Your Name PLEASE PRINT _____

Address _____

_____ Postcode _____

Daytime Phone No. (AREA CODE) _____

Email _____ @ _____

Payment details:

☐ Cheque/Money Order enclosed

OR Charge my ☐ Visa Card ☐ MasterCard

No: ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐

Signature _____ Card expiry date ☐☐ ☐☐

BOOK TOTAL: $..... PLUS P&P: $..... **ORDER TOTAL$ AU**.....

POST TO: Silicon Chip Public., PO Box 139, Collaroy NSW, Australia 2097; OR CALL (02) 9939 3295 & quote your credit card details; or FAX TO (02) 9939 2648

1-08

*ALL TITLES SUBJECT TO AVAILABILITY. PRICES VALID FOR MONTH OF MAGAZINE ISSUE ONLY. ALL PRICES INCLUDE GST

ASK SILICON CHIP

Got a technical problem? Can't understand a piece of jargon or some technical principle? Drop us a line and we'll answer your question. Write to: Ask Silicon Chip, PO Box 139, Collaroy Beach, NSW 2097 or send an email to silchip@siliconchip.com.au

Solar trackers for panels or reflectors

I think there is a need for a project to help the solar power industry.

Solar panels are expensive and their output varies with the amount of sunlight striking the panel. The intensity could be optimised by additional reflectors that are moved to keep the panels' output at maximum for as long as possible. The project would monitor the intensity on each panel and bring the reflectors to bear as required, with controlled motors. (G. T., Londonderry, NSW).

● The adding of adjustable reflectors or making the panels track the sun does increase output. However, the inevitable energy input for the tracking facility often means that any increase in output over a full day is fairly marginal.

If you have a large solar panel array, its weight or the weight of any reflector panels will be considerable as they need to be engineered to withstand high winds. If you then make the solar array (or the reflector panels) moveable to track the sun, the additional weight will require a considerable amount of power to move it.

Having said that, we published a design for a solar tracker to suit a single panel in the January 1995 issue of SILICON CHIP. We can supply the back issue for $9.50 including GST and P&P (Australia) or $A13.00 each including airmail (outside Australia).

Is solar-powered air-conditioning practical?

Could you please tell me if solar power for caravans can run air-conditioners? If we went solar for our van we would want to be able to run the air-conditioner, lights and television. If this were possible, what would the cost be? (P. C., Crystal Brook, SA).

● We turned your question over to Collyn Rivers, who has written a number of very good books on solar power. In fact, one of them is reviewed in this month's issue. Here is his reply:

It is possible but not practical to run even the most efficient air-conditioners from solar energy in a caravan. At present, air-conditioners made specifically for RVs are, with rare exceptions, not nearly as efficient as their better domestic counterparts. Like fridges, air-conditioners do not generate "cold" as such. They are simply pumps that move heat from where it's not wanted to where it does not matter (eg, from inside a house to the outside air).

Currently, the most efficient domestic air-conditioners use about 450W to produce 2500W of cooling but many RV units use close to double that. If run from 12/24V, inverter losses would increase that to 500W – about 41A at 12V – and as battery charging is only about 90% efficient, this increases the demand for the air-conditioner alone to about 46Ah solar input for each hour the unit is in use.

That equates to about 370Ah per every eight hours' usage.

Translating this into solar module terms: a typical 130W solar module realistically produces about 90W. This will typically result in 360 watt/hours, ie, about 30Ah/day.

As we need about 370Ah for every eight hours use, this requires a minimum of 12 such modules (at a cost of approximately $18,000). If you need to have the air-conditioning running for longer than eight hours most costs increase proportionally. In some places one can assume 5-6 such sun-hours but doing that is better avoided for reliable operation.

Few caravans have roof space sufficient for more than half the above – nor can they support the weight of about 15kg per module.

There's worse! For the above to be even remotely practicable (most of the solar energy is available only for three or so hours either side of noon), that 370Ah input must be stored in a battery bank.

Most affordable batteries can only be routinely discharged to about 40% remaining charge, so the minimum-sized bank needs to at least 600Ah. That lot will weigh about 200kg and cost about $1200. If run 24 hours/day, you are looking at a 600kg battery bank.

The above relates only to current state-of-the-art air-conditioning. A typical RV unit will need up to double that solar input and battery capacity.

The current solution is to run air-conditioning only where 240VAC mains power is available or to use a

Very Low Speed Motor Control

Please let me commence by saying I am a complete ignoramus in this field but I do like doing things for myself if possible. I have a working electric motor that came from a paper shredder. It is labelled 230V 50Hz 54W.

One of my hobbies is making fishing rods. Part of the process is applying epoxy to the bindings which can take 24 hours to dry. To ensure a smooth finish, the rod should be rotated at about 10 RPM for that period.

I need something to allow me to regulate the speed of the motor. Can you suggest a suitable circuit? (B. R., via email).

● We have published motor speed controllers for 230V mains motors (eg, SILICON CHIP, October 2002) but because you are inexperienced with electrical wiring we cannot recommend you build one. In addition, the motor would not run smoothly at 10 RPM using such a controller.

Instead, why not use a low-voltage motor and gearbox? Jaycar have the YG-2730 motor and gearbox that can be set to run at 11.27 RPM. It is also safe and runs on 3V using two 1.5V batteries or a DC power supply.

quiet inverter generator such as the Honda/Yamaha units; this removes the need for batteries and a separate inverter. A single 130W module plus a 100Ah battery can adequately supply the remaining requirements.

In the medium-term, LPG powered fuel cells plus ever increasingly efficient (domestic) air-conditioning technology will provide an answer to running RV air-conditioning from solar. It is now done domestically – but requires exceptionally large solar installations, such as our neighbour's $300,000 (truly!) system that runs four of them.

I might also comment that medical advice is that the ongoing thermal shock of moving frequently in and out of air-conditioned vehicles in hot places causes major physiological stress. While thermally acclimatised (we live permanently in Broome), we do not have air-conditioning in our home or TVan camper trailer. (Collyn Rivers, Caravan & Motorhome Books, Broome, WA 6725.)

Note: Collyn Rivers was the founder editor of "Electronics Today International" which together with "Electronics Australia" were the antecedents of Silicon Chip. Collyn is the author/publisher of the directly-RV related and globally selling "Solar That Really Works"; and also the just published "Solar Success" (the latter includes RVs but mainly covers home and property systems). His websites are at:
www.caravanandmotorhomebooks
www.successfulsolarbooks

Puzzlement over battery charger

The circuit for the 12V lighting controller (Silicon Chip, January 2008) is of interest to me as I wanted to adapt the concept for charging an SLA battery (12V 1.3Ah) for a cordless drill which is used infrequently. The problem I have is that the mains power for the charger is not always present and so the battery is discharged by the charger when mains power is off.

My charger (Jaycar MB-3517) is similar to the one you use in this project in that no voltage is present on the charger terminals until the battery is connected, hence the charger does not start if you isolate the battery via a diode to prevent discharge when power is off.

How then does your circuit work when the charger is isolated from the battery by Schottky diode D1? Jaycar info for your charger states that it will not charge a totally flat battery, ie, zero volts at the charger terminals. (B. P., Glenbrook, NSW).

- We are puzzled by your statement that with your SLA battery-charging set-up, the battery is discharged by the charger when the mains power is not present. This should not occur, because the rectifier diodes in the charger should not allow current to flow back into the charger from the battery when there is no mains power.

The same function is provided by diode D1 in the 12V Lighting Controller. There is no disruption of the automatic charging action as a result of diode D1 being in series with the battery, because the only effect of D1 is to increase the apparent terminal voltage of the battery by about 390mV (as seen by the charger). If anything, the Schottky diode makes the battery appear to be less discharged than it actually is.

Transformer for Studio 350 amplifier

I am currently building the first of two Studio 350 amplifier modules (Silicon Chip, January & February 2004). Is the recommended transformer (50V+50V 500VA) for this amplifier capable of powering two amplifier modules? I intend driving 8-ohm speakers but don't want to lose the capability of driving 4-ohm loads.

Would the performance of the amplifiers benefit from independent power supplies or would a higher-rated transformer be satisfactory? As I only intend using the amplifiers to power a home stereo system, hopefully the transformer can handle the power demand. Is there a way I can check that the transformer is coping with the load, eg, by measuring the voltage across the supply rails?

What do you recommend as the total capacitance? Also, if sharing the power supply between the two amplifiers, should the number of 8000µF 80V capacitors be increased? (L. C., Campbelltown, NSW).

- A single 500VA power supply is OK except for all but the most demanding applications where you might require full power from both channels for a significant period.

If you are concerned about whether the transformer is adequate, you

PIC Programmer Comparison Is Confusing

I have been comparing the PIC programmer published in May 2008 with the one published in September 2003. They are pretty well the same, as you would expect, but there is a major difference with regard to the PGM Program pin.

The 2003 programmer was designed for use with 18-pin chips (16F84 and 16F628 etc) and an add-on could be made to take the 28 and 40-pin chips. The 2008 programmer was designed for use with 40-pin chips such as the 16F877 but could also be used with 28-pin and 18-pin chips.

In the 2003 programmer, the PGM pin on the 18-pin socket (pin 10) is pulled to ground via a 4.7kΩ resistor. Also in the article is a small add-on circuit for a 28-pin chip. In this add-on, the PGM pin (pin 24) is also pulled to ground using a 4.7kΩ resistor.

In the 2008 programmer, however, the PGM pins on the 18, 28 and 40-pin sockets are all connected directly to the +5V rail. This is because these pins are also used as power connections on other chips.

So what should it be? 4.7kΩ to ground or directly to the +5V rail? (P. O., via email).

- The 2008 dsPIC/PIC Programmer connects all those pins to the +5V rail, as you say. This is OK since the PGM pin is not used for programming the PICs. Instead, the MCLR-bar/Vpp pin (pin 1 or pin 4) is used for the programming voltage (Vpp).

When the voltage on the MCLR-bar/Vpp pin rises to around 13V, the PIC enters programming mode. Programming commands and data are then sent serially using the PGC (clock) and PGD (data) lines.

In other words, the PGM line is not used for programming but merely to supply Vcc (supply voltage).

12-24V DC Speed Controller Queries

I have been studying the motor controller circuit in the March 2008 issue and I notice that all components are on the same side of the board, so it means that the Mosfets are lying on the epoxy rather than the copper. No wonder the FETs run hot! If you don't mind me saying so, that is a very strange arrangement indeed.

They cannot be turned over and put on the copper side as the leads would not line up. I do intend to build one of these so I have decided I would stand them upright and bolt an angled 16G copper or 3mm aluminium heatsink onto them where they are situated now under the tab. That should enable loads of 50A or 60A at a significantly lower operating temperature.

I happen to want to run two 500W motors in parallel on 24V in a model train so I know I will be running the controller at its limit. If necessary, I would be prepared to use a separate supply for each motor but a much cheaper solution is to just slightly beef up a single controller, especially when I think that a sizable heatsink is going to be necessary anyway.

My other concern is with the 55V rating of the FETs. I once came across an old rule of thumb that stated that the FETs should be rated four times the battery voltage. Is this a valid rule still? The IRF1405 is designed specifically for automotive use and that means 14V. If you multiply 13.8V by four you get almost exactly 55. This cannot be a coincidence.

Now I wonder if you have run this circuit in a real-life vehicle on a 24V power supply? I once blew a 60V (60N06) Mosfet in a five-Mosfet parallel array on a large heatsink on a 24V supply, powering a 5-inch gauge model train. I could never be sure of the cause of the failure so I decided to replace them all with 100V types and had no more trouble, even under some periods of "rough" use when the train was dragging its brakes. Even that big heatsink got hot then, so it was a real test!

On that rule, these Mosfets should be rated at 100V for a 24V supply. But there is no 24V equivalent to the IRF1405 (that I can find) so it would probably have to be an IRF540N with a rating of 33A.

I have not yet worked out the thermal gradients for this one but it would certainly mean a decent-sized heatsink and the use of perhaps two extra Mosfets. I would appreciate your comments on these two issues. (P. D., via email).

● The rationale for not including heatsinks was because we did not think the speed controller would need to handle 40A for greatly extended periods.

Most motors only draw large currents at start up, under very heavy load or when stalled. At other times they can be expected to pull much smaller currents. Therefore, any normal motor installation requiring a 40A rating would not be expected to run at this maximum current all the time.

A continuous 40A current rating also means a very large battery capacity, otherwise the batteries would be exhausted very quickly.

The Mosfets will get hot with 10A running through them, ie, 40A in total. This was mentioned in the article, where the junction temperature will be around 80°C at 10A. With the typical RDS(on) of 5.3 milliohms, the power dissipation with 10A is close to 0.53W.

So if you want to run the speed controller near its operating maximum for extended periods, it would be prudent to add a heatsink to the Mosfets as you suggest. For most applications though, a heatsink should not be necessary.

In relation to your comments regarding the 55V rating of the Mosfets, we agree that a higher rating would be desirable, at first glance. However, the IRF1405 Mosfets are cheap and readily available and the specified 33V 5W zener diode was found to offer effective protection, even under the most severe conditions.

The 33V zener would also still be required even if higher-rated Mosfets were used, because it is needed to suppress voltage transients which could damage other parts of the circuit, possibly including the microcontroller. Hence, there would be no real advantage in fitting higher-rated Mosfets.

We did perform a number of extended tests on the speed controller at 24V and 40A but this is quite difficult using a suitably rated motor on its own, unless you have a dynamometer set-up. Our approach was to use the featured motor with a brake load, together with a resistive dummy load to bring the current up to 40A continuous.

could monitor the supply rails with your multimeter while the amplifier is delivering high power. However, if you are listening to normal program material (eg, from a CD player), there is likely to be negligible fluctuation. There is no point in increasing the capacitance on the supply rails.

Luxeon bed light

I propose to build a pair of bed light units using 3W Luxeon LEDs and your StarPower supply described in the May 2004 issue. It would be fed from a mains-derived DC source, so I will probably omit the "low battery" components.

It would be nice to have dimming capability. Would there be any objection to running a pair of flying leads from the trimpot location and installing a suitable potentiometer? (R. T., Doncaster East, Vic).

● You could use VR1 as a dimming control provided that the 3.6kΩ resistor in series is altered so the maximum LED current is not exceeded when VR1 is in its maximum level position. The sense resistor R1 may need to be larger in value to get sufficient dimming range. However, make sure that R1 is not dissipating excess power for its wattage rating.

Electric braking for a caravan

Some time ago, I built your "Highly Flexible Keypad Alarm" (SILICON CHIP, April 2003). It worked like a charm

until recently. While it appeared to set correctly (the LED came on), opening the normally closed loop did nothing and at the same time the ability to respond to either 1000 or 2000 to set or unset was lost, and only one entry code (1000) worked.

Another matter you may be able to help me with is that I am buying a new caravan. To operate the van's electric brakes I purchased a "Hayman Reese Electronic Brake Controller" which is smaller than a normal pendulum type and which fits my car.

Upon application of the car brakes (stop light circuit), the controller applies the van brakes. It uses a 313Hz oscillator and pulse width control, with a transistor as the controlling element, I assume. You can set the attack rate and the amplitude separately but there is no input from the towing vehicle as there would be with the pendulum type.

With a previous home-built pendulum type controller I designed a few years ago for a much bigger vehicle (a Landrover 110), I had room to incorporate a moving-coil ammeter in series so I could tell visually the amount of braking being applied. With this new unit I would like an ammeter but don't have room for a moving-coil type.

However, I found a likely solution in the LED Bargraph Ammeter, in the January 1999 issue of SILICON CHIP. I will obviously not need the 555 IC or the negative supply and assume I will connect pin 4 of IC1a to 0V (earth).

I will make a manganin resistance shunt for about 6-7A (which a previous van's brakes required.) What voltage drop would be required across the shunt to fully light up all the LEDs? (N. W., via email).

● The keypad alarm can usually be redeemed by tying the instant and delayed inputs to 0V, then pressing the 3, 6, 9 & * keys simultaneously while you apply power. The status LED will light. Then switch off power and reapply power after releasing the switches. The default settings will then be restored.

If this does not work, the code in the PIC may be corrupted and it will have to be reprogrammed.

Concerning your brake driver, the 7A shunt only needs to provide a voltage drop of between 40mV and 800mV to show a full LED display. As an alternative to measuring current, you could just measure the pulse width by clamping the PWM signal from the brake driver at say 5.1V using a zener and series resistor and applying this to the pin 5 input to IC2 via a trimpot divider. The signal can be filtered to average out the pulses to a DC value. That way you only need IC2, REG1 and the LEDs. IC1 and IC2, etc will not be required. The bar mode is enabled by connecting pin 9 to pin 3. SC

Universal Remotes & The RC5 Code

I bought a kit for the PC Infrared Receiver (SILICON CHIP, August 2003) and I have some questions. The device is assembled and I can see hex signals being received on the COM port but only with one remote, ie, the remote for my car stereo.

If I try any other remote, no signals are seen. I've tried several TV remotes, a VCR/DVD remote, my universal learning remote (Zensonic) and my Yamaha AV amplifier remote, all with no result. Have I "formatted" the microcontroller to accept only the first type of signals? Is this project programmed to accept only some remote codes? (M. D., via email).

● As detailed in the August 2005 issue, the receiver is designed to work with universal remotes. It generally will not work with specific remotes for a particular piece of equipment.

Universal remotes can be programmed to send an RC5 code which is what the PC Infrared Remote Receiver requires. The RC5 code is used with most Philips or affiliated brands of equipment. Select one of the pre-programmed codes for Philips brand units as detailed in the instructions for the universal remote.

In addition, the PC Infrared Remote Receiver will accept Sony Playstation codes if a Playstation remote is used.

Notes & Errata

USB Clock with LCD Readout, October 2008: there is an error in the circuit on page 21. Pin 43 (D+) of the microcontroller should connect to pin 3 of the USB type B socket. Similarly, Pin 42 (D-) of the microcontroller should connect to pin 2 of the USB type B socket. The circuit shows these two connections swapped.

WARNING!

SILICON CHIP magazine regularly describes projects which employ a mains power supply or produce high voltage. All such projects should be considered dangerous or even lethal if not used safely.

Readers are warned that high voltage wiring should be carried out according to the instructions in the articles. When working on these projects use extreme care to ensure that you do not accidentally come into contact with mains AC voltages or high voltage DC. If you are not confident about working with projects employing mains voltages or other high voltages, you are advised not to attempt work on them. Silicon Chip Publications Pty Ltd disclaims any liability for damages should anyone be killed or injured while working on a project or circuit described in any issue of SILICON CHIP magazine. Devices or circuits described in SILICON CHIP may be covered by patents. SILICON CHIP disclaims any liability for the infringement of such patents by the manufacturing or selling of any such equipment. SILICON CHIP also disclaims any liability for projects which are used in such a way as to infringe relevant government regulations and by-laws.

Advertisers are warned that they are responsible for the content of all advertisements and that they must conform to the Trade Practices Act 1974 or as subsequently amended and to any governmental regulations which are applicable.

MARKET CENTRE

Cash in your surplus gear. Advertise it here in SILICON CHIP

CLASSIFIED ADVERTISING RATES

Advertising rates for these pages: Classified ads: $29.50 (incl. GST) for up to 20 words plus 85 cents for each additional word. Display ads: $54.50 (incl. GST) per column centimetre (max. 10cm). Closing date: 5 weeks prior to month of sale.

To book your classified ad, email the text to **silicon@siliconchip.com.au** and include your name, address & credit card details, or fax (02) 9939 2648, or post to Silicon Chip Classifieds, PO Box 139, Collaroy, NSW, Australia 2097.

Enclosed is my cheque/money order for $_____ or please debit my

❑ Visa Card ❑ Master Card

Card No. | | | | | | | | | | | | | | | |

Signature_____ Card expiry date____/____

Name _____

Street _____

Suburb/town _____ Postcode_____

Phone:_____ Fax:_____ Email:_____

Degen 1103 Pocket Receiver

Range 100kHz - 29,999kHz, direct entry, digital display. Listen to SSB, amateur radio, marine weather, HF aircraft, shortwave and many more. Supplied with rechargeable AA batteries, approved charger, 10m longwire, carry case and earphones. $159.00 + P/H.

Contact Av-Comm Pty Ltd
Tel: (02) 9939 4377; www.avcomm.com.au

FOR SALE

RCS RADIO/DESIGN is at 41 Arlewis St, Chester Hill 2162, NSW Australia and has all the published PC boards from SC, EA, ETI, HE, AEM & others. Ph (02) 9738 0330. **sales@rcsradio.com.au; www.rcsradio.com.au**

CUSTOMERS: Truscotts Electronic World – large range of semiconductors and passive components for industry, hobbyist and amateur projects including Drew Diamond. 27 The Mall, South Croydon, Melbourne. (03) 9723 3860. **electronicworld@optusnet.com.au**

FACTORY OUTLET: flexible neon wire. Sheet (Backlight cuttable) flower. LGP Backlight. EL products. Phone 041 771 8607 Fax (07) 3397 5787. Email: **cjappliance@gmail.com**

PCBs MADE, ONE OR MANY. Any format, hobbyists welcome. Sesame Electronics Phone (02) 9593 1025. **sesame@sesame.com.au www.sesame.com.au**

TECH REPAIRS SERVICE MANUALS
www.techrepairs.org
Thousands of downloadable service manuals for all brands, makes and models including PDP, LCD, VCR, DVD, CTV, Vintage Radio, Laptops, Monitors, Sewing Machines, Washing Machines, Dryers, Fridges and many

continued page 96

PROTOTYPING ????
PROTOTYPING ! ! ! !
Make your own quality prototype circuit boards with Quick Circuit
SATCAM
www.satcam.com.au
E: satcam@satcam.com.au Tel: +61 2 9807 7081
Models available for less than $10,000

- **More frequent updates – every 2.5 seconds!**
- **More alarm settings – over 70 parameters!**
- **More highs, lows and graphs – over 80 in all!**

With the **Vantage Pro2 Weather Station** you get incredibly detailed information on:
Wind – direction and strength
Rainfall – current, recent patterns etc.
Temperature – current, wind chill, etc.
Barometric pressure – current and trends
Humidity & dewpoint – current and 24 hrs
And your own local forecast. You'll be more accurate than the weather bureau!
Available in wired or wireless models (wireless transmission up to 300m!)

ECOWATCH
Unit 5, 17 Southfork Dve Kilsyth, Vic 3137
Tel: (03) 9761 7040 Fax (03) 9761 7050
www.davisinstruments.com.au

scientTECH
Innovative Technology Ecosystem
Two Channel CDMA (DSSS and FHSS) Trainer

ST2117
Two Channel CDMA (DSSS and FHSS) Trainer is a training system to explore the fundamentals in CDMA.
■ Data generators ■ PN sequence generators
■ DSSS modulators and Multiplexer and many more..
We offer comprehensive training solutions in Electronics and Communications through our extensive range of training systems.
Contact: Geo Electronics, Phone: 0401687587
Email: geoelectronics@engineer.com
www.scientech.bz

VIDEO - AUDIO - PC
distribution amps - splitters
digital standards converters - tbc's
switchers - cables - adaptors
genlockers - scan converters
bulk vga cable - wallplates

DVS5c & DVS5s High Performance Video / S-Video and Audio Splitters

MD12 Media Distribution Amplifier
QUEST
Quest AV

VGA Splitter VGS2

HQ VGA Cables

AWP1 A-V Wallplate
Come to the specialists...
QUESTRONIX
Quest Electronics® Pty Limited abn 83 003 501 282 t/a Questronix
Products, Specials & Pricelist at www.questronix.com.au
fax (02) 4341 2795 phone (02) 4343 1970
email: questav@questronix.com.au

TAIG MACHINERY

Taig Micro Mill 2000 including 4th axis and MACH software
$3000.00

Mini Lathe 280 X 300 with all accessories
$700.00
59 Gilmore Crescent Garran ACT 2605
(02) 6281 5660
0412 269 707

MW MEAN WELL ON-LINE IN-STOCK

Computronics Corporation Ltd
6 Sarich Way, Technology Park, BENTLEY, WA, 6102
Ph. : 08 9470 1177, Fax: 08 9470 2844
www.computronics.com.au/meanwell

SPLat CONTROLS Tough times demand innovative solutions!
In tough economic times you need to watch every dollar. SPLat embedded controllers give OEMs more functionality per dollar than any competing product. Check out our website today and discover how we can help you remain competitive.

Made in Australia, used by OEMs world-wide
splat-sc.com

20 years experience! SPEAKERBITS
HI-FI SPEAKER REPAIRS
YOUR EXPERT SPEAKER REPAIR SPECIALISTS
Specialising in UK, US and Danish brands.
Speakerbits are your vintage, rare and collectable speaker repair experts. Foam surrounds, voice coils, complete recone kits and more. Original OEM parts for Scan-Speak, Dynaudio, Tannoy, JBL, ElectroVoice and others!
tel: 03 9647 7000 www.speakerbits.com

ELNEC IC PROGRAMMERS

High quality
Realistic prices
Free software updates
Large range of adaptors
Windows 95/98/Me/NT/2k/XP
CLEVERSCOPE USB OSCILLOSCOPES
2 x 100MSa/s 10bit inputs + trigger
100MHz bandwidth
8 x digital inputs
4M samples/input

Sig-gen + spectrum analyser
Windows 98/Me/NT/2k/XP
IMAGECRAFT C COMPILERS
ANSI C compilers, Windows IDE
AVR, TMS430, ARM7/ARM9
68HC08, 68HC11, 68HC12
GRANTRONICS PTY LTD
www.grantronics.com.au

Printed Circuit Board Manufacture
48-Hour service * High quality * Low prices
1 offs to any quantity
Artwork design if required
Call for obligation free quote...
INSTANT PCBs, POBox 448, Avalon 2107
Ph (02)9974 1189 Fax (02)9974 5491

Surplus Electronic Components ABN: 38 445 311 223
www.excesselectronics.com.au
30mcd Dark Blue SMD Led (Pk-100)
AB687
$ 3.00
Excess Electronic Components
PO Box 2417
Rowville Vic 3178
Tel: 041 567 7761
Fax: 03 9755 8280
On-line Shopping Range Of Excess Electronic Parts
FREE MONTHLY MAILER Please Enquire
sales@excesselectronics.com.au
FREE FREIGHT FOR ORDER OVER $100

Quality batteries to suit
SONY BPL90 V LOCK & ANTON BAUER DIONIC

Portable charger for mains or 12V vehicle supply also available
SALE
PREMIER BATTERIES PTY LTD
(02) 9755 1845
email: malcolmw@premierbatteries.com.au
web: www.premierbatteries.com.au

Do You Eat, Breathe and Sleep TECHNOLOGY?

Opportunities for full-time and part-time positions all over Australia & New Zealand

Jaycar Electronics is a rapidly growing, Australian owned, international retailer with more than 50 stores in Australia and New Zealand. Our aggressive expansion programme has resulted in the need for dedicated individuals to join our team to assist us in achieving our goals.

We pride ourselves on the technical knowledge of our staff. Do you think that the following statements describe you? Please put a tick in the boxes that do:

- ☐ Knowledge of electronics, particularly at component level.
- ☐ Assemble projects or kits yourself for car, computer, audio, etc.
- ☐ Have empathy with others who have the same interest as you.
- ☐ May have worked in some retail already (not obligatory).
- ☐ Have energy, enthusiasm and a personality that enjoys helping people.
- ☐ Appreciates an opportunity for future advancement.
- ☐ Have an eye for detail.

Why not do something you love and get paid for it? Please write or email us with your details, along with your C.V. and any qualifications you may have. We pay a competitive salary, sales commissions and have great benefits like a liberal staff purchase policy.

Send to:
Retail Operations Manager - Jaycar Electronics Pty Ltd
PO Box 107, Rydalmere, NSW 2116
Email: jobs@jaycar.com.au

Jaycar Electronics is an equal opportunity employer and actively promotes staff from within the organisation.

Jaycar Electronics

RFMA RF Modules Australia

Low Power Wireless Connectivity Specialists

Parani-ESD1000
OEM Bluetooth Module
In Stock NOW!
AT Interface
Power: +18dBm
Range of upto 1Km
Bluetooth Spec: V2.0+EDR

Applications:
Laptop/PDA comms, control & measurement.
Rural
Industrial
Commercial

Parani-SD100
Bluetooth Serial Adapter
In Stock NOW!
Range 100m to 1Km
No drivers
Class 1
Data rate: upto 115200bps

SENA: OEM Bluetooth Modules and Serial Adapters

RF Modules Australia. P.O. Box 1957 Launceston, TAS., 7250.
Ph: 03-6331-6789. Email: sales@rfmodules.com.au. Web: rfmodules.com.au

Battery Packs & Chargers

Siomar Battery Engineering
www.batterybook.com
Phone (08) 9302 5444

Gooligum Electronics

Christmas Star still available
Full kit: $39 + P/H
www.gooligum.com.au

DOWNLOAD OUR CATALOG AT
www.iinet.net.au/~worcom
WORLDWIDE ELECTRONIC COMPONENTS
PO Box 631, Hillarys, WA 6923
Ph: (08) 9307 7305 Fax: (08) 9307 7309
Email: worcom@iinet.net.au

more. An absolute must have website for any Tech!

LEDs! NICHIA SUPERBRIGHT LEDs, Cree XR-E and 5mm LEDs, Avago (HP) LEDs, many other standard and superbright brand name LEDs. Plus, see our new range of nixie clocks! **www.ledsales.com.au**

WANTED

WANTED: EARLY HIFIs, AMPLIFIERS, Speakers, Turntables, Valves, Books, Quad, Leak, Pye, Lowther, Ortofon, SME, Western Electric, Altec, Marantz, McIntosh, Tannoy, Goodmans, Wharfedale, radio and wireless. Collector/Hobbyist will pay cash. (07) 5471 1062. **johnmurt@highprofile.com.au**

KIT ASSEMBLY

KEITH RIPPON KIT ASSEMBLY & REPAIR:
* Australia & New Zealand;
* Small production runs.

Phone Keith 0409 662 794.
keith.rippon@gmail.com

Advertising Index

Alternative Technology Assoc.	79
Altronics	loose insert
Amateur Scientist CDs	IBC
Av-Comm	94
CJ Appliance	94
Computronics	95
Dick Smith Electronics	22-23
Dynalite	61
Ecowatch	94
Emona Instruments	11
Gooligum Electronics	96
Grantronics	95
Harbuch Electronics	81
Hare & Forbes	OBC
High Profile Communications	96
Instant PCBs	95
Jaycar	IFC,45-52,96
JED Microprocessors	5
Keith Rippon	96
LED Sales	96
MicroZed Computers	7,39
Ocean Controls	6
Ozitronics	81
Premier Batteries	95
Prime Electronics	67
Quest Electronics	95
RCS Radio	94
RF Modules	96
Rockby Electronics	95
Satcam	94
Sesame Electronics	94
Silicon Chip Binders	56
Silicon Chip Bookshop	88-89
SC Perf. Electronics For Cars	34
Silicon Chip Subscriptions	77
Siomar Battery Industries	96
Soundlabs Group	43
Speakerbits	95
Splat Controls	95
Taig Machinery	95
Tech Repairs	94
Tekmark Australia	61
Tenrod Australia	9
Tribotix	3
Truscotts Electronic World	94
Wagner Electronics	41
Worldwide Elect. Components	96

PC Boards

Printed circuit boards for SILICON CHIP designs can be obtained from RCS Radio Pty Ltd. Phone (02) 9738 0330. Fax (02) 9738 0334.

NEW! V3 SUPER SCIENCE FAIR EDITION!

THE AMATEUR SCIENTIST

Two incredible CDs with over 1000 classic projects from the pages of Scientific American, covering every field of science...

NEW UPDATED VERSION ALSO INCLUDES BONUS SCIENCE SOFTWARE LIBRARY!

Arguably THE most IMPORTANT collection of scientific projects ever put together!
This is version 3, Super Science Fair Edition from the pages of Scientific American.
As well as specific project material, the CDs contain hints and tips by experienced amateur scientists, details on building science apparatus, a large database of chemicals and so much more.

SCIENTIFIC AMERICAN
Dr. Shawn
THE AMATEUR SCIENTIST 3.0
The Complete Collection
Super Science Fair Edition
Instructions to perform over 1,000 classic experiments from every field of science
Includes bonus Science Software Library
"The science deal of the century."
Ages 12 to Adult
John Bollinger

ONLY $62.00

PLUS $7 Pack and Post within Australia

NZ P&P: $AU12.00, Elsewhere: $AU18.00

"A must for every science student, science teacher, science lab . . . or simply for those with an enquiring mind . . ."

Just a tiny selection of the incredible range of projects:

• Build a seismograph to study earthquakes • Make soap bubbles that last for months • Monitor the health of local streams • Preserve biological specimens • Build a carbon dioxide laser • Grow bacteria cultures safely at home • Build a ripple tank to study wave phenomena • Discover how plants grow in low gravity • Do strange experiments with sound • Use a hot wire to study the crystal structure of steel • Extract and purify DNA in your kitchen •Create a laser hologram • Study variable stars like a pro • Investigate vortexes in water • Cultivate slime moulds • Study the flight efficiency of soaring birds • How to make an Electret • Construct fluid lenses • Raise butterflies as experimental animals • Study the physics of spinning tops • Build an apparatus for studying chaotic systems • Detect metals in air, liquids, or solids • Photograph an ant's brain and nervous system • Use magnets to make fluids into solids • Measure the metabolism of an insect . . . • and many, many more (a thousand more, in fact!)

See the V2 review in SILICON CHIP, October 2004. . . or read on line at siliconchip.com.au

HERE'S HOW TO ORDER YOUR COPY:

BY PHONE:*
(02) 9939 3295
9-4 Mon-Fri

BY FAX:#
(02) 9939 2648
24 Hours 7 Days

BY EMAIL:#
silchip@siliconchip.com.au
24 Hours 7 Days

BY MAIL:#
PO Box 139,
Collaroy NSW 2097

BY INTERNET:^
siliconchip.com.au
24 Hours 7 Days

* Please have your credit card handy! # Don't forget to include your name, address, phone no and credit card details. ^ You will be prompted for required information

There's also a handy order form inside this issue (see SILICON CHIP Bookshop pages).

Exclusive in Australia to: **SILICON CHIP** www.siliconchip.com.au

HARE&FORBES MACHINERYHOUSE

VISIT OUR NEW WEBSITE

On Special

more Technical details online

Navigation

- Home
- Products
- Used Equipment
- New Releases
- Bargain Bin
- Spare Parts
- Order Catalogue
- Contact Us
- Careers

Product Categories

- Metalworking
- Sheetmetal
- Woodworking
- CNC Machinery
- Machine Tool Accessories
- Measuring Equipment
- Workshop Equipment
- Lifting & Handling
- Used Equipment
- Bargain Bin

Download

You will need Adobe Acrobat Reader to download some of our documents.
Download it now >>

Get Adobe Reader

*All prices include G.S.T.

Specifications and prices are subject to change without notice & are valid until 19-12-08.

5_SC_NOV_08

Specials - 53 Found

HAND SHEARS

GREAT VALUE

4mm Shear, 150mm Blade $109 (S186)

6.5mm Shear, 300mm Blade $169 (S188)

X3 MILL DRILL

- Precision dovetail vertical slide
- Electronic variable speed (100-2000rpm) with 2-speed gearbox
- 3MT Spindle
- 25mm Mill & Drill capacity

$1,750 (M153)

OPTIONAL STAND $275 (M154)

MeasumaX SCRIBERS

Double Ended Scriber 190mm
~~$9.50~~ $8.55 (70-630)

Pocket Scriber 145mm
~~$19.95~~ $17.95 (70-631)

precision measuring instruments
Now there's an alternative

BS-4A BANDSAW

$309 (B002)

- Vertical table
- 100 x 150mm capacity
- 3-Speed 1/2HP motor
- Cast iron construction

MAGNETIC BASE & DIAL GAUGE

- Mag-Base: ON/OFF switch
- Dial gauge 0-10mm

$59 (M055)

WORKBENCHES

- Heavy duty steel fabricated
- Comes with lockable draws

2000x640x870mm
$419 (A380)

PUNCH CHASSIS HYDRAULIC SET

$255 (P020)

Dies: 22, 27.5, 34.3, 43, 49, 60.8mm

AL-60 LATHE

- 550W 240V,
- 550mm BC

$1,295 (L148)

MILL At.

- 350W
- Tilts ±45

$675 (M151)

OPTIONAL STAND EXTRA

RETRACTABLE HOSE REELS

Water -12mmx15mtr $89 (H030)

Air -10mmx15mtr $89 (H032)

Air -10mmx20mtr $115 (H034)

Air -10mmx20mtr $219 (H040)

G-CLAMPS

DROP FORGED STEEL

100mm $17 (G500)
160mm $25 (G501)
200mm $39 (G502)

- Drop forged ultra strong ribbed body
- Steel screw with swivel anvil

4PCE CASTER WHEELS

- 2 x Fixed & 2 x Swivel with Brake
- 35mm wide wheel
- Wheel capacity 70kg each
- Mounting plate 102 x 80mm with 4 holes

$49 (C410)

WET & DRY VACUUM CLEANER

- 1400W 240V
- Large 60L S.Steel Tank
- 240V Power Tool Outlet

$269 (V500)

BUFFING KIT

$45 (G185)

- Suits 8" grinders
- 16mm RH thread

6 PCE WELDER PACK

- Chipping Hammer
- Steel wire brush
- Hand scratch brush
- Welding Knee Pads (1 Pair)
- Welding Gloves with heat resistance function (1 pair)
- Comfortable fitting welding helmet

$49 (W108)

9 PCE WELDER PACK

- Chipping Hammer • 10" Welding forking clamp
- Welder Angle Holder covering (45, 90, 135°) x 2
- 6" C-Clamp • 8" Sheet metal clamp
- Lightweight comfortable welding helmet
- Soft cow split leather welding gloves (large size)
- Apron with excellent heat resistance & protection

$69 (W109)

STICK & TIG WELDERS

- DC TIG function
- Arc leads included
- Electrode hot start & arc force
- Voltage & thermal overload protection
- High strength case

ARC 140II $349 (W165)

ARC 160II $495 (W164)

8" BENCH GRINDER BG-200

$169 (G159)

- 550W induction motor 240V
- Cast aluminum toolrests
- Safety lamp

scheppach

bts 900x LINISHER

$199 (L105)

- Quick release for belt change
- Tilt linishing table 0-90°
- Linishing work area 100 x 280mm
- 6" disc
- Induction motor 240V

scheppach

Deco Flex 16" SCROLL SAW

scheppach

- 90W variable speed
- Tilt table 0-45°
- Low voltage lamp
- 35mm duct port blower
- Flexible shaft drive

$199 (W348)

ACCES KIT $29 (W348A)

WET STONE GRINDER

$495 (W865)

scheppach

- Leather hone 200 x 30mm
- 200W induction motor
- 250x50mm K220 Al. oxide wheel
- Rotation speed 90 rev/min
- Complete with grinding paste, angle master, jig for straight edge chisels
- Designed for uninterrupted operation
- Ideal for tradesman

Made in Germany

PRICES INCLUDE G.S.T.